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U. S. DEPARTMENT OF AGRICULTURE

DIVISION OF CHEMISTRY

BULLETIN No. 37

# RECORD

OF

# EXPERIMENTS WITH SORGHUM

IN

1892

BY

HARVEY W. WILEY

*Chemist of the U. S. Department of Agriculture and Director of the Department Sugar Experiment Stations at Schuyler, Nebraska; Runnymede (Narcoossee P. O.), Florida, and Sterling and Medicine Lodge, Kansas*

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# LETTER OF TRANSMITTAL.

U. S. DEPARTMENT OF AGRICULTURE,
DIVISION OF CHEMISTRY,
*Washington, D. C., December 31, 1892.*

SIR: I have the honor to submit for your inspection and approval the manuscript of Bulletin No. 37 of the Division of Chemistry, being a record of experiments conducted on the culture of sorghum during the year 1892 by authority from you, under my direction.

Respectfully,

H. W. WILEY,
*Chemist.*

Hon. J. M. RUSK,
*Secretary.*

# EXPERIMENTS WITH SORGHUM IN 1892.

The experiments in the culture of sorghum were continued during the season of 1892 at the experiment station at Sterling, Kans., and also at the experiment station at Medicine Lodge, Kans. The selected seeds planted at both places were those produced at the experiment station at Sterling during the season of 1891.

## EXPERIMENTS AT MEDICINE LODGE.

Sixty-five acres of land were planted with sorghum at Medicine Lodge, including the 15 acres on the station near the village, and 50 acres leased from farmers in the vicinity. The conditions of the lease were that no variety or plat should be grown within 300 yards of any other variety or within the same distance of any plat of broom corn. The object of this isolation of each variety was to secure immunity from admixture with any other variety or with broom corn. Each plat which was grown by the farmers consisted of 1 acre and was planted in a single variety from the selected seed heads grown at Sterling. In general it was observed that it required about 40 seed heads to plant 1 acre, giving to each plat three or four times as many seeds as it was desired to have mature stalks of sorghum at the time of harvest.

The direction of the planting and the control of the culture and the general conduct of the work were intrusted to Mr. C. I. Hinman. The cultivation of the 15 acres grown by the station was intrusted to Mr. Eli Benedict.

In general, the farmers discharged the obligations with fidelity and secured an excellent cultivation of the plats committed to their care.

Mr. Hinman kept an accurate field record of all the varieties planted and also notes in regard to the character of the season.

The spring was very cold and wet. The summer was unusually hot and dry, the thermometer standing at over 100° in the shade for several consecutive days. During April 0.49 inches of rain fell, while in May, which was a cold month, the rainfall was 4.65 inches. June was a warm month with a rainfall of 2.85 inches. July was very hot, with hot winds and only 0.76 inches of rain. August was very hot, with 2.42 inches of rain. September was hot, with 0.84 inches of rain. During October 3.44 inches of rain fell. Frost was somewhat earlier than usual, having killed the leaves on the cane on the evening of October 8.

On each plat of cane cultivated accurate field notes were taken showing the method of preparation of the seed bed, time of planting, and all the agricultural data. It would add unnecessary length to this report to incorporate all these data in full. A sample, therefore, will be given of the method of keeping them.

*Block 47.*

| | |
|---|---|
| Planted | On station. |
| Variety of cane | Collier. |
| Preparation of seed bed | Subsoiled fall of 1891. Plowed April 28 and 30 to a depth of 11 inches and afterwards harrowed, rolled, and reharrowed. |
| Area and kind of seed planted | The area of this block was 3.57 acres, and of this ten 1,000-foot rows were planted with 50 seed heads* and the remainder of the block with 9½ pounds bulk seed. |
| Time of planting | May 2 and 3. |
| Method of planting | By hand, 8 to 12 seeds in a hill, hills 2½ feet apart, rows 3 feet 7½ inches apart. |
| Time of coming up | May 7 and 9 and beginning to head out August 4. |
| Character of cultivation | Cultivated 7 times, hoed 5 times, and harrowed once. |
| Thinning | By hand, when cane was about 7 inches high. leaving from 5 to 6 of best and most vigorous stalks in each hill. |
| Growth notes | Plat vigorous at start; continued so until August when west end was damaged by extremely hot and dry weather. |
| Time sampled | October 5, 6, 7. |
| Weight of samples | 3 tons. |
| Time harvested | October 11, 12, 13. |
| Weight of cane delivered to mill | 22 tons. |
| Total tonnage of topped cane | 25 tons. |
| Yield per acre | 7 tons. |
| Seed heads selected | 3,101. |
| Average weight of seed head | 0.85 ounce. |
| Kind of soil | Upland. |

As an illustration of the method of preserving the pedigree of the seed grown, the following instance may be taken, showing how a given stalk of sorghum cane produced at Medicine Lodge during the summer of 1892 can be traced directly to the original parent of the Colman variety selected at Sterling in 1887:

In 1887 a stalk of peculiar appearance, evidently a cross between amber and orange, was selected at Sterling by Mr. Denton. The juice of the cane was not analyzed. In 1888 this seed head was planted on plat No. 153 and a large number of selections made from the progeny produced. One of these seed heads was produced by a stalk having

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* These seed heads had a perfect pedigree recorded in the books of the Department. An illustration of the method of keeping this pedigree is given on pages 8, 9, and 10.

16.85 per cent of sugar in the juice, with a purity of 74.96. This represented the best individual produced from the canes analyzed from the original seed head. This seed head was planted in 1889 on plat 291, producing as before a large number of progeny from which numerous selections were made. One of these seed heads selected was produced by a stalk of cane which had in the juice 18.35 per cent sucrose, with a purity of 73.87. This represented the best of the individuals produced and selected during that season. In 1890 this seed head was planted on plat No. 129 and produced a numerous progeny from which selections were made, one of the best of which was produced by a cane having a content of sugar in the juice of 17.81 per cent and a purity of 80.63. This was planted in 1891 at Sterling on plat 75 and produced a seed head which was numbered 12475. This seed head was produced by a cane having in its juice 19.4 per cent of sucrose and a purity of 81.10. This seed head was planted at Medicine Lodge in 1892 on block 11, and produced a large number of progeny, from which selections were made. Among the best of these is the one which has been numbered 9643, and was produced by a cane having in its juice 17.7 per cent of sucrose and a purity of 83.20. This individual seed head will be planted separately next year, and in this way the direct line of transmission will be preserved.

This is only an illustration of the method by means of which 88,100 seed heads which have been selected during the past year at Medicine Lodge and Sterling can be traced back to their original ancestors through many generations.

In order to show the average effect of seed selection there will be given also the genealogy of the seed selections on part of block 47 at Medicine Lodge during the past year. This block was planted in Collier cane, a variety obtained by Dr. Collier from South Africa in 1882, and the seed of which was sent by him to the Sterling station in 1888. No selections, however, were made from this seed by analysis during that year, but it was grown and planted the following year, 1889. The appended table shows the genealogy of the selections made from one seed head at Medicine Lodge on the block 47 as stated.

When it is remembered that each acre contained at least 40 separate seed heads the magnitude of the work of preserving the genealogy will be appreciated.

In the table under the different years are given, first year, 1889, the content of sugar in the juice of individual selections that year and the purity. Under the following year, 1890, is given the analysis of one of the progeny of 1889. In 1891 this individual produced a large number of seed heads, of which those selected under 1891 are given with the analysis of the stalk bearing them. In all, 11 seed heads were selected from the progeny of 1890, and these 11 seed heads formed a part of the 40 seed heads planted on block 47.

Under 1892 are given in the table the number of canes selected from each of the corresponding parents of 1891. For instance, the parent of 1891, which had 17.8 per cent sucrose in the juice and with a purity of 74. 8, gave 27 selections in 1892, the average percentage of sucrose in the juice of which was 20.93 and the average purity 81.5. In all, 449 seed heads were selected in 1892 from the 11 parents of 1891, from the 1 parent of 1890, from the 1 parent of 1889.

*Pedigree of Collier, block 47.*

| 1889. | | 1890. | | 1891. | | 1892 - Progeny. | | |
|---|---|---|---|---|---|---|---|---|
| In juice. | | In juice. | | In juice. | | No. selected canes. | In juice. | |
| Sucrose. | Purity. | Sucrose. | Purity. | Sucrose. | Purity. | | Sucrose. | Purity. |
| *Per cent.* | *Per cent.* | *Per cent.* | *Per cent.* | *Per cent.* | *Per cent.* | | *Per cent.* | *Per cent.* |
| 18.82 | 76.4 | 17.40 | 78.6 | 17.8 | 74.8 | 27 | 20.93 | 81.5 |
| | | | | 17.3 | 74.6 | 54 | 19.40 | 76.8 |
| | | | | 17.1 | 74.7 | 63 | 20.11 | 77.0 |
| | | | | 18.0 | 74.4 | 60 | 20.71 | 79.5 |
| | | | | 17.0 | 73.2 | 29 | 20.00 | 79.4 |
| | | | | 16.6 | 74.4 | 7 | 19.50 | 85.6 |
| | | | | 17.8 | 75.1 | 16 | 21.06 | 81.0 |
| | | | | 17.7 | 75.0 | 25 | 20.61 | 75.6 |
| | | | | 17.8 | 75.1 | 50 | 19.04 | 76.4 |
| | | | | 17.5 | 76.5 | 91 | 18.20 | 70.1 |
| | | | | 17.3 | 74.1 | 27 | 19.30 | 81.0 |
| Means. | .......... | .......... | .......... | 17.36 | 75.4 | 449 | 19.60 | 77.33 |

The above table may be taken as the text for an interesting study which could be applied with equal force to thousands of recorded pedigreed heads. The variety of Collier cane grown in 1888 from seed sent by Dr. Collier grown in 1882 was not very promising. Only four analyses were made of the variety in 1888. The means of these were sucrose 12.31 per cent, reducing sugars 73 per cent, and purity 71.69. Nevertheless, on account of low reducing sugars and high purity these seeds were planted in 1889, and it is very fortunate that they were, for by reason of acclimatization or some other cause this cane rapidly developed an aptitude to the soil and climate of Kansas, and in the selections of canes grown in 1889 there was one found which had the high sugar content and purity given in the table.

Now in the work of seed selection it is not expected that the average character of the progeny should equal the excellence of the particular parent selected. All that is claimed is that there will be a tendency sometimes in the progeny for one of them to approach, equal, or excel that good character which the original parent had. It is not strange therefore that in 1890 the very best of the selected canes failed to equal the character of the parent of the year before. Nevertheless, we found in 1891 a large number of individuals approaching the excellence of the original parent of 1889, and much to our gratification in 1892 find the means of all the selected analyses show that several of the progeny give a result better than that of the original selection.

Thus by continued selection from the best varieties we have been able to establish permanently a variety which in its average results shows almost if not quite as good a character as the one especial parent originally selected for the propagation. This is a striking illustration of the success of the method of seed selection in gradually establishing a variety with qualities approaching that of some particular individual which in its natural variation has shown itself possessed of extraordinarily favorable properties.

During the latter part of August, when the cane began to ripen, the work of seed selection was commenced. The samples were taken late in the afternoon for the work of the following morning and late in the forenoon of each day for the work of the afternoon. In this way the samples were brought to the laboratory in practically a fresh condition, not more than a few hours intervening between the cutting of the samples and the analysis of the juices. An account was kept of the weight of the canes taken for samples, so that at the time of the harvesting of the rest of the canes the total yield per acre could be determined. The analytical data and general results of the seed selection work will be found in the tables which follow.

In the analytical work a distinction was made between the canes grown from pedigreed seed heads whose ancestry could be traced back for several years and what is known as bulk seed, that is, seed coming from high grade cane, but taken from a whole plat without analysis of the juices of the canes bearing it.

In all, 32,849 selections were made from the pedigreed seed, and the average sucrose content of the juices of the canes furnishing these seeds was 17.22.

The Collier cane led all the other varieties in the percentage of sucrose, the average percentage of the selected stalks being 18.99; the average of 5,506 samples.

The McLean cane took the second rank in respect of sucrose, with 18.42 per cent, the average of 2,193 samples.

Coleman cane occupied the ninth position, with an average of 15.79 per cent of sucrose, the average of 6,553 samples.

Folger cane occupied the tenth position, with an average of 15.53 per cent of sucrose, the average of 2,255 samples.

In respect of the purity of the juices the McLean variety occupied the first rank with an average purity of 77.99; Collier the second, with an average purity of 77.13; Folger the ninth, with an average purity of 72.90; Colman the tenth, with an average purity of 72.10.

In respect of yield per acre, the Orange variety gave the best results and occupies first place, showing a yield of 13 tons per acre and a value as delivered at the factory of $28.60.

Colman occupies the second rank, with a yield of 9.02 tons per acre and a value of $20.75.

Folger occupies the fourth position, with a yield of 8.72 tons per acre and a value of $18.31.

Collier occupies the sixth position, with a yield of 7.11 tons per acre and a value of $16.35.

McLean occupies the thirteenth position, with a yield of 6.01 tons per acre and a value of $13.22.

The valuation of the other varieties grown at Medicine Lodge will be found in the table printed further on.

The method of preparing the samples selected for seed purposes for examination was a simple one. The stalks were stripped of their leaves and were then brought to four small Pioneer mills driven by a shaft from a common horse power. Each stalk was run through the mill separately. In order to hasten the time of passing through, the butt of the stalk was first presented to the rolls. As soon as it became engaged the attendant cut the stalk into three pieces, putting each piece in separately and preserving the seed head with about 18 inches of stalk attached thereto.

The juice from the mill was collected in a tin vessel holding about a quart. This was removed from underneath the mill, the seed head laid across its top, and passed on to the desk where the specific gravity was roughly taken by means of a Brix spindle.

The standard of each variety having been fixed at a certain percentage of total solids, this percentage was roughly determined by means of a spindle, the samples falling below the standard being rejected and the seed heads belonging thereto thrown away. When the sample reached or went above the standard fixed, it was passed on to the tagger, who attached to the vessel containing the juice a gum label with a given number and tied to the seed head a shipping tag bearing the same number. The samples of juice were then passed to the total solids table, where the total solids were determined with accuracy by a calibrated Brix spindle and the temperature of the determination noted. The seed heads thus preserved were collected together and suspended in bundles from the rafters of the building, after having had placed on their tags the percentage of sucrose determined by the analysis of the juice coming from each stalk bearing each individual head. The juices were passed on to the laboratory, where they were prepared for polarization and polarized in the usual way.

The analyses of average samples, that is of a considerable quantity of cane coming from a given plat taking every stalk within the space harvested, were carried on in the same way, with the exception that in addition to the total solids and sucrose the percentage of reducing sugar was also determined.

The number of analyses per day averaged about 1,600, and the number of stalks ground per day about 5,000. Practically two-thirds of the stalks on an average were rejected as not coming up to the standard fixed.

An interesting study was made in the comparison of the parent canes of the previous year with the progeny produced at Medicine Lodge during 1892.

In the case of Folger, 106 parent canes grown at Sterling in 1891 were compared with 1,879 of the progeny of these canes produced at Medicine Lodge in 1892. The average percentage of sucrose in the parent canes was 15.31 and in the progeny 15.53. The average purity of the juices of the parent canes was 73.14 and of the progeny 72.2.

With the Collier variety, 49 parent canes were compared with 1,993 of their progeny with the following results: In the parent canes the average sucrose was 17.17 per cent and the average purity 75.5. In the progeny the average sucrose was 20 per cent and the average purity 78.50.

In the Colman variety, 51 parent canes were compared with 1,781 of their progeny. In the parent canes the average sucrose was 15.80 per cent and the average purity 75.92. In the progeny the average sucrose was 16.07 per cent and the average purity 71.04.

Of the McLean variety, 40 parent canes were compared with 793 of their progeny. In the parent canes the average sucrose was 17.5 per cent and the average purity 76. In the progeny the average sucrose was 18.73 per cent and the average purity 78.50.

In all the varieties studied at Medicine Lodge, 732 parent canes were compared with 19,301 of their progeny. The mean result for all the samples of every variety was the following:

| | In the parent canes. | In the progeny. |
|---|---|---|
| | *Per cent.* | *Per cent.* |
| Average sucrose in the juice | 16.08 | 17.03 |
| Average purity of the juice | 75.70 | 74.02 |

From the above it is seen that in the progeny there was a considerable increase in the percentage of sucrose and a slight decrease in the purity of the juice.

From the whole number of seed selections made, a certain number of the highest grade was selected for special propagation in 1893. These selections were made from those canes showing the best qualities for sugar production of the whole number examined. For the four standard varieties which have been mentioned the number of such selections was as follows:

| Variety. | Total number of heads selected for propagation. | Average sucrose. | Average purity. |
|---|---|---|---|
| | | *Per cent.* | *Per cent.* |
| Collier | 330 | 20.06 | 82.5 |
| McLean | 391 | 19.20 | 81.7 |
| Colman | 273 | 17.12 | 80.9 |
| Folger | 516 | 16.18 | 77.4 |

The total number of selections of all varieties for propagation numbered 2,520, and the average sucrose in the juice of the canes bearing these seed heads was 17.88, and the average purity of the juices 80.48, Allowing 40 seed heads for an acre, it is seen that a little over 63 acres could be planted with the selections made; an ample area for the experimental work of another season.

The amount of analytical work which was done in connection with the above selections can be seen from the following summary:

| | | |
|---|---|---|
| Selections from pedigreed plats | 32,849 | |
| Selections from bulk-seed plats | *17,063 | |
| Total | | 49,912 |
| Average samples | 783 | |
| Special samples | 25 | |
| Analyses not selections | | 808 |
| Total analyses | | 50,720 |

The amount of work which was done by the Department during the past year in the development of the sorghum cane is far greater than that of any other previous year, and this is due to the fact of the operation of two separate stations instead of one. In addition to this each station did a much larger amount of work than has ever been done before by a single one.

It is not believed that it is necessary that the work should be continued in more than one station in Kansas. Nevertheless the attention of the different State experminent stations should be called to the fact that the Department has secured this large number of specially selected and pedigreed seed heads for propagation, and it would be well for all those States whose climate and soil are suitable to the culture of sorghum to continue the work in the lines indicated by the results obtained by the Department. In this way a variety or varieties of cane might be produced especially suitable to each locality where grown.

The United States Department of Agriculture has gone to the expense of not only indicating the method by which such work should be accomplished, but of doing it on a scale which has never been equaled by any similar undertaking anywhere in the world, not even excepting the beet-sugar seed production farms of Europe.

## EXPERIMENTS AT STERLING.

At the Sterling station 175 acres of land were leased for the culture work. The object of getting so large an area of land was to enable the different plats to be planted at a sufficient distance apart to prevent crossing when it was not desired. The land was plowed from 4 to 5 inches deep, harrowed once and in some instances twice.

---

* By "bulk seed" is meant the seed of highly bred strains which is not selected by individual analysis. Only a part of the progeny of each seed head is examined individually, but the tendency to produce progeny of a high character is shared in common by every individual of the whole plat. When, therefore, the selections have been completed the seed of the remaining individuals of the plat is harvested as a whole. Some of the best individual canes are naturally produced from such bulk seed.

Planting was commenced on the 8th of April and ended on the 30th of June, thus continuing over a period of eighty-three days. Two hundred and eighty-seven small plats were planted; most of them with seeds from selected seed heads of greatly superior quality. One hundred and nine large areas were planted with mixed seed from high-grade cane. The small plats were planted by hand, while the larger were planted by drill. An average of 2 pounds of seed was planted per acre. Some replanting was necessary. The ordinary cultivation was given, the hoe being used on some plats to reduce the plants to a proper number per acre.

The season was rather favorable to the production of cane and the best crop which has been secured by the Department at Sterling was grown. The quality of the canes was also satisfactory. The experience of the work shows that earlier plantings require a longer period to reach maturity than the later ones, which might be inferred from the character of the season.

The main object of the year's work was to reduce the number of varieties by selecting a few superior ones. The so-called varieties of sorghum are based upon very small botanical differences, not sufficient to distinguish them botanically, but simply agriculturally, hence a very great many varieties may be produced, but they are so nearly alike that it does not seem necessary to establish them by long years of careful selection. The few superior varieties which have already been established, which are quite distinct in their nature, offer all the inducements necessary for the continued propagation of a high grade of sorghum cane.

In general, the experience of the work at the station has shown that hand-planting gives a much more uneven and irregular stand of cane than machine-planting, but there is no other way of planting selected seed heads except by hand, as it would require too much trouble to put so small a quantity of seed into a drill for planting purposes. It is in general advised to roll the land as soon as the canes appear, as it makes it possible to cultivate closer and thus diminish the amount of hand labor required.

As a general result of the work, four varieties have been selected out of all which have been investigated, for the continuation of improvement work in the future. These varieties are Folger, Collier, McLean, and Colman.

Folger is the best early maturing variety. It undoubtedly originated in a cross of Amber and Link, as reversions may be found in its canes to both these varieties, but the general type of the variety is now firmly established. It has all the advantages of early maturation of the Amber cane and is superior to it in every respect—in yield per acre, sugar content, and general sugar-making qualities.

The Collier variety is recommended as the best variety for the more northern latitudes in which sorghum is grown for sugar. It has an abundance of foliage, which is quite persistent and resistant to frosts. The canes are quite slender, yet it always stands up well because the seed heads are light. It has a high content of sucrose and a fair purity. It ripens reasonably early and can be planted as late as June 15 in favorable localities.

The McLean variety has been grown at the station for three years. It gives quite large canes and grows very tall. It seems well suited to the climate of Kansas, and has always since its introduction shown a high percentage of sugar. The type is not yet firmly established, inasmuch as when the seed was originally received from Australia it consisted of two distinct types, and the pure McLean type has not yet been as firmly established as could be desired.

The Colman variety was originated at the station in 1888 by a cross between Amber and Kansas Orange. At first the type was very variable, but now it has become firmly established, and there is no variety of sorghum which has been grown which gives as good results in the sugarhouse as the Colman.

The analytical work at Sterling embraced the analysis of average samples from the different plats to determine their value for sugar production, together with the usual analyses to determine the selection of seed heads by the character of the juice of the cane bearing them. The analytical results have been collected into tables showing the various properties of the different plats which were in cultivation.

The number of days required from the time of planting until the standard varieties reached 11 per cent of sugar is as follows:

| | Days. |
|---|---|
| Colman | 135 |
| McLean | 135 |
| Collier | 140 |
| Folger | 142 |

The dates on which the leading varieties reached 11 per cent of sucrose are as follows:

| | |
|---|---|
| Folger | Aug. 29 |
| McLean | Aug. 29 |
| Collier | Sept. 5 |
| Colman | Sept. 7 |

The number of days required for each of the leading varieties to attain a purity of 70 per cent is as follows:

| | Days. |
|---|---|
| Colman | 135 |
| McLean | 139 |
| Collier | 144 |
| Folger | 149 |

The dates on which the leading varieties attained a purity of 70 per cent are as follows:

| | |
|---|---|
| McLean | Sept. 4 |
| Colman | Sept. 7 |
| Collier | Sept. 9 |
| Folger | Sept. 12 |

The relative position of the leading varieties, based on analysis of average samples, for the maximum per cent of sucrose is as follows:

| | Per cent sucrose in juice. |
|---|---|
| Collier | 18.50 |
| McLean | 17.24 |
| Colman | 16.93 |
| Folger | 15.57 |

The dates on which the leading varieties reached their maximum percentage of sucrose, as based on the analysis of average samples, is as follows:

| | |
|---|---|
| Folger | Sept. 26 |
| McLean | Sept. 28 |
| Colman | Sept. 29 |
| Collier | Sept. 30 |

The relative rank of the leading varieties in respect of maximum glucose, based on the analysis of average samples, is as follows:

| | Per cent reducing sugar in juice. |
|---|---|
| McLean | 0.44 |
| Collier | 0.49 |
| Colman | 0.50 |
| Folger | 0.91 |

The dates on which the leading varieties showed their minimum percentage of reducing sugar, as determined by the analysis of average samples, are as follows:

| | |
|---|---|
| Colman | Sept. 25 |
| McLean | Sept. 26 |
| Folger | Sept. 27 |
| Collier | Sept. 28 |

The relative position of the leading varieties in respect of the maximum purity, based on the analysis of average samples, is as follows:

| | Purity. |
|---|---|
| Collier | 78.15 |
| Colman | 77.95 |
| McLean | 76.80 |
| Folger | 74.75 |

The dates on which the leading varieties reached their maximum purity, based on the analysis of average samples, are as follows:

| | |
|---|---|
| McLean | Sept. 22 |
| Collier | Sept. 27 |
| Folger | Sept. 27 |
| Colman | Sept. 27 |

The relative position of the leading varieties, based on their mean percentage of sucrose, from the analysis of average samples, is as follows:

| | Mean percentage of sucrose. |
|---|---|
| Collier | 18.43 |
| Colman | 17.79 |
| McLean | 16.92 |
| Folger | 14.87 |

The relative position of the leading varieties, as determined by their mean purity from the analysis of average samples, is as follows:

| | Mean purity. |
|---|---|
| Colman | 77.99 |
| McLean | 77.47 |
| Collier | 76.02 |
| Folger | 72.88 |

The mean value of the leading varieties in respect of maximum sucrose for five years' experiment is as follows:

| | |
|---|---|
| McLean | Rank 1 |
| Colman | Rank 2 |
| Collier | Rank 3 |
| Folger | Rank 4 |

The relative rank of the leading varieties for five years, based on the means of their minimum glucose, is as follows:

| | |
|---|---|
| McLean | Rank 1 |
| Collier | Rank 2 |
| Colman | Rank 3 |
| Folger | Rank 4 |

The relative rank of the leading varieties for five years, based on the mean of their maximum purities, is as follows:

| | |
|---|---|
| McLean | Rank 1 |
| Colman | Rank 2 |
| Collier | Rank 3 |
| Folger | Rank 4 |

From the total number of seed heads selected for propagation from the leading varieties during the season of 1892 the following data are taken:

*Percentage of total number falling within the limits given below.*

[Percentage of sucrose in juice.]

| Variety. | Below 11. | 11. | 12. | 13. | 14. | 15. | 16. | 17. | 18. | 19. | 20. | 21. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Colman | 1.26 | 0.74 | 1.39 | 3.81 | 6.68 | 11.28 | 29.41 | 32.40 | 10.59 | 1.65 | 0.79 | 0 |
| Collier | 0.01 | 0.05 | 0.15 | 0.80 | 1.93 | 7.13 | 17.00 | 28.83 | 29.98 | 12.85 | 1.20 | 0.01 |
| McLean | 0.10 | 0.24 | 1.29 | 6.05 | 15.31 | 21.48 | 23.71 | 22.74 | 8.23 | 0.69 | 0 | 0 |
| Folger | 0.87 | 2.42 | 11.73 | 32.35 | 38.50 | 13.52 | 0.55 | 0.02 | 0 | 0 | 0 | 0 |

[Purity coefficient in juice.]

| Variety. | Below 70. | 70. | 71. | 72. | 73. | 74. | 75. | 76. | 77. | 78. | 79. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Colman | 15.21 | 2.67 | 3.87 | 4.73 | 5.92 | 7.94 | 10.90 | 13.47 | 14.10 | 11.81 | 5.47 |
| Collier | 10.69 | 2.99 | 4.62 | 5.43 | 8.70 | 12.49 | 15.29 | 14.27 | 12.00 | 7.11 | 3.19 |
| McLean | 6.57 | 3.28 | 4.92 | 7.61 | 11.03 | 15.10 | 15.96 | 14.66 | 10.79 | 6.27 | 1.99 |
| Folger | 63.58 | 8.96 | 11.11 | 7.76 | 4.59 | 2.24 | 0.90 | 0.48 | 0.21 | 0.06 | 0.05 |

| Variety. | 80. | 81. | 82. | 83. | 84. | 85. | 86. | 87. | 88. | 89. | 90. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Colman | 2.21 | 1.09 | 0.33 | 0.14 | 0.03 | 0.04 | 0.02 | 0.02 | 0 | 0.01 | 0.02 |
| Collier | 1.29 | 1.50 | 0.11 | 0.18 | 0.05 | 0.09 | ...... | ...... | ...... | ...... | ...... |
| McLean | 0.86 | 0.40 | 0.43 | 0.13 | ...... | ...... | ...... | ...... | ...... | ...... | ...... |
| Folger | 0.02 | 0.01 | 0.01 | 0 | 0.01 | 0 | 0.01 | ...... | ...... | ...... | ...... |

Experiments were also made to determine the relative keeping qualities of the different varieties. They were cut and placed in small piles in a shady place, covered with trash and this trash kept moist.

*Table showing the keeping qualities of the different varieties.*

| Variety. | Date. | Sucrose. | Glucose. | Purity. |
|---|---|---|---|---|
| | | *Per cent.* | *Per cent.* | *Per cent.* |
| McLean | Oct. 6 | 19.20 | 0.51 | 78.40 |
| | Oct. 29 | 15.45 | 7.10 | 62.90 |
| Collier | Oct. 6 | 20.10 | 0.31 | 76.80 |
| | Oct. 29 | 17.21 | 6.92 | 66.04 |
| Colman | Oct. 6 | 18.70 | 0.62 | 79.20 |
| | Oct. 29 | 17.81 | 4.00 | 74.36 |
| Folger | Oct. 6 | 17.70 | 1.03 | 76.70 |
| | Oct. 29 | 15.28 | 4.23 | 76.17 |

From the above table it is seen that it is not always safe to depend upon the determination of the sucrose alone in regard to observing the qualities of the cane. In each instance it is seen that while there was not a great loss of sucrose, yet there was a great increase in glucose and decrease in purity. The natural drying out of the cane would maintain the sucrose content in the juice up near the normal, while the sugar-producing quality of the cane was greatly deteriorated.

The following is a statement of the average analysis of the different varieties of cane from the time they were first grown by the Department up to the present. The great increase in the sugar content and the purity for the year 1892 must be regarded as due largely to climatic conditions, and it is not probable that this high character of the cane will be preserved without occasional reversions to less favorable composition:

| Variety. | 1888. | | | 1889. | | | 1890. | | | 1891. | | | 1892. | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Mean percentage sucrose. | Mean percentage glucose. | Mean purity. | Mean percentage sucrose. | Mean percentage glucose. | Mean purity. | Mean percentage sucrose. | Mean percentage glucose. | Mean purity. | Mean percentage sucrose. | Mean percentage glucose. | Mean purity. | Mean percentage sucrose. | Mean percentage glucose. | Mean purity. |
| Collier | 12.31 | 0.73 | 71.69 | 14.91 | 0.75 | 76.95 | 15.95 | 0.59 | 74.77 | 14.80 | 0.90 | 73.80 | 18.50 | 0.49 | 78.19 |
| Colman | | | | 14.58 | 1.15 | 75.55 | 14.88 | 0.84 | 76.38 | 15.60 | 0.73 | 76.30 | 16.93 | 0.50 | 77.95 |
| Folger | | | | 14.08 | 2.03 | 76.54 | 14.12 | 1.75 | 74.91 | 14.60 | 1.35 | 73.30 | 15.57 | 0.91 | 74.75 |
| McLean | | | | | | | 15.22 | 0.52 | 76.00 | 16.40 | 0.55 | 77.40 | 17.24 | 0.47 | 76.85 |

The above data while they show variations and occasional reversions and retrogradations, yet indicate most clearly a gradual and in some cases rapid improvement in the character of the variety. There is a tendency to the production of a larger quantity of sucrose, a smaller quantity of glucose, and a higher purity. This is due solely to the principle of selection, by means of which an attempt is made to propagate only such individual samples of any given variety as have in a high degree the characteristics necessary for successful sugar growing.

The amount of analytical work which was accomplished at Sterling is only faintly indicated by the above selections from the work. The analytical work was commenced on the 20th of August and continued until the 1st of October. The working force in the laboratory consisted of twenty-seven men. In all, 37,403 seed selections were made and 1,772 analyses of average samples. The average number of analyses made per day was 1,399. Only about 25 per cent of the total number of canes brought in for selection passed the first test of specific gravity, and the total number of canes which were milled separately and the specific gravity test taken was 156,700.

In addition to the experiments in the improvement of the sorghum cane carried on at Sterling, considerable work was done in determining the varieties best suited to the manufacture of molasses, and the best methods of manufacture from the farmer's point of view. While this work was not intimately connected with sugar production, yet it will prove of some interest to the small farmer who grows only a small area of cane solely for the purpose of supplying himself or his neighbor with molasses. The results of chemical analysis alone would be sufficient to show that some varieties of sorghum are much better suited to sirup-making than others. The development of varieties of cane especially for sugar production would in some respects unfit them for the manufacture of molasses alone, for the reason that the certain granulation which would ensue after the molasses is boiled to the proper density would render it unfit commercially for table use. In all, about 4,000 gallons of sirup were made during the experiments, and the quality of much of it was equal to the molasses made from sugar cane by the open-kettle process. Unfortunately, all of the molasses which was made showed a tendency to crystallize and some of it became converted entirely into mush sugar. This fault could easily be foretold from the character of the cane worked.

### DIFFERENT METHODS OF CLARIFICATION.

Different methods of clarification were tried for the purpose of making a high grade of molasses. Among these we may mention clarification with lime, clarification with lime and clay, clarification with lime and tannin, clarification with lime and some acid, and cold clarification with acid.

First, in regard to the lime process it may be stated that when lime is employed it is not used to saturation, but the juice is left distinctly acid, so that the bright color of the molasses may be preserved. The clarification made in this way must, therefore, be imperfect as far as any good effect of the lime is concerned. Lime always tends to darken the resulting product, and therefore its use in the manufacture of molasses must be very generally condemned.

Experiments were also made, as indicated above, with the combination of lime and clay. In this case about 1 per cent of bisulphite of lime solution is added to the fresh juice as it comes from the mill. A thick creamy mixture of lime and clay is added to the boiling juice. The addition of clay is necessary to secure a rapid subsidence of the flocculent matter. The resulting molasses is usually of fine flavor and color.

The lime and tannin process is one which has been long in use, having been described as long ago as 1847. It consists in the use of tannic acid in some form added to the fresh juice before any other clarifying agent is used. Clarification with the use of tannic acid has also been tried in the Louisiana Sugar Experiment Station, and in general the results are regarded as favorable. In this process it appears that lime removes one class of impurities, the tannic acid removes another class, and the resulting juice is clear and bright.

The process which rests on the combination of lime with an acid has been practiced also for many years. Phosphoric acid is the one which is preferred on account of the perfect precipitation of the added lime which is secured. This process secures a sirup of bright color and fine flavor. This process has been tried in all sugar-producing countries and gives apparently good results, yet it has not come into general use, inasmuch as in sugar-producing countries, it is no longer an object to secure a light-colored product, but a large yield without reference to color.

The method of combining lime with carbonic acid has been thoroughly worked out by the Department, and with excellent results in so far as the yield of sugar is concerned. There is probably no known method by which so large a yield of sugar can be obtained from a given quantity of juice as by the application of the treatment employed in beet-sugar factories, known as carbonatation or saturation, namely, the addition of a large excess of lime and its subsequent precipitation by means of a current of carbonic acid.

With sorghum juice, cold clarification has some decided advantages. Especially when these juices have been expressed by a mill the starch grains which they contain will have opportunity to subside during cold clarification. If hot clarification be employed the starch grains will soften and distribute in a pasty mass uniformly throughout the whole of the juice. The addition of clay, of course, hastens the precipitation of all suspended bodies mechanically. It is doubtful whether the clay has any specific effect upon the clarification itself, but it acts simply as a mechanical carrier, by means of which the subsidence of the flocculent matters is hastened. The fact that clay added to cold juice which has been properly limed gives a better separation of the impurities, a brighter, clearer liquid, which is more easily filtered and which gives less scum during evaporation, may be easily verified by laboratory experiments and also by work in a factory.

The process which gave the best results during the experimental work consisted in liming the cold juice until a good clarification was secured, adding lime when necessary until the juice was decidedly alkaline and the color red, the criterion being the proper clarification and not the color. This was followed by the addition of clay mixed to the consistency of batter in sufficient quantity to increase the density of the well-stirred liquid about 1° Baume or 2° Brix. The whole mass was then allowed to settle, the time required being from one to two hours. The clear liquid was then drawn off from the surface by a swing valve, proper care being taken to leave all the settlings in the tank. The clear liquid was run into a clarifying tank, phosphoric acid was then added until the liquor was slightly acid, as determined by litmus paper. It was then heated nearly to the boiling point and the scums thoroughly removed. The juice was again allowed to settle for half an hour to an hour, and drawn off again from the surface downward by a swing valve, care being taken not to remove any of the settlings. The light-colored and bright juice is then filtered. With such a clear liquid filtering seems unnecessary, yet it gives increased brightness to the molasses. No pressure was used in the filter press, and the cloths did not require frequent changing. The clarified liquid was then sent to the evaporating tank and reduced to the consistency of molasses.

This method gives a good product, but, of course there is a great waste inasmuch as the settlings could not be filtered but had to be thrown away. When the object is to secure a high grade molasses for household use, without reference to the economy of manufacture, the process could doubtless be used to good advantage.

The cost of the phosphoric acid, it was estimated, was not over one-third of a cent per gallon.

The process of liming the juice may be more minutely described for the benefit of those who are not accustomed to it. Cream of lime is prepared by mixing a well-slaked lime with water to the consistency of a cream and filtering it through a fine sieve to remove all large particles. It is highly important that no large particles of undissolved lime be present in the cream. This cream of lime is added slowly to the cold juice as it comes from the mill and thoroughly mixed. Blue litmus paper, which has been made red by dropping it in the fresh juice, should be immersed in the limed juice. When the reddened litmus paper shows a slightly blue tinge of color it indicates that the juice is slightly alkaline. If this is not the case more lime should be added until the juice becomes alkaline. A test-tube should now be filled with the limed juice, placed in the light, and allowed to remain at rest for five minutes. The liquor, as seen in the test tube, should be bright, clear, and transparent. If it is not, more lime should be added to the juice and the test should be repeated. With some juice it is necessary to add lime until it becomes strongly alkaline and reddish in color, while other juices liming to the neutral point or to slight alkalinity give a proper result. In all cases cream of lime must be added until the juice becomes clear and bright in order that a good clarification may be secured.

Two points should always be borne in mind. If too little lime be used the juice will not be well clarified, and if an unnecessary amount of lime be used it will require excessive use of phosphoric acid to remove it. Practice will soon determine very nearly the amount of lime required, but the exact proportion should always be finally determined by the appearance of the limed juice in the test tube.

Experiments show that the yellow or red clays are best suited for this purpose. They should be well mixed to a uniform batter with water and strained to remove all coarse particles. Enough of the clay should be added to the limed juice to increase its density sufficiently to cause a rapid settlement of the particles. The amount of clay depends upon many factors and can easily be determined by a few experiments. In general, from 1 to 2 pounds of clay to 100 pounds of juice are found sufficient. As soon as the juice has been limed and clayed and well mixed it can be tested by means of the test glass as indicated for the liming, and if it does not settle with sufficient rapidity an additional amount of clay can be added. A tank, 36 inches deep, filled with cold limed and clayed juice should give about 30 inches of clear juice and 6 inches of settlings in from one to two hours. The time depends upon the temperature, the density of the juice, and the quantity of the clay. When the clear juice has been drawn from the settling tank, leaving the impurities with the clay, the lime having done its work, should be entirely removed from the juice by the addition of phosphoric acid. One hundred and eight gallons of the acid phosphate of calcium, sometimes called superphosphate of lime, were used in the experiments. A preparation of phosphoric acid, known as clariphose, essentially an acid calcium phosphate, may also be used. About 1 gallon of acid phosphate to 400 or 500 gallons of juice should be employed. The amount of acid required depends upon the quantity of lime which was used in the clarification, and, for this reason, it is desirable to use no more lime than is necessary to secure the desired results. The phosphoric acid combines with the lime-forming tricalcium phosphate which is insoluble and is at once precipitated, thus removing both the lime and the acid present in the juice. The natural organic acids which were originally present in the juice are thus set free, and produce the required acidity for the production of a light-colored and highly flavored product. It is important that both the phosphoric acid and the lime should be entirely removed, and, for this reason, no excess of acid phosphate should be employed. The proper method of determining this is also in a test tube, in which it can be determined whether or not the precipitation is complete. Time should now be given for the phosphate of lime which is formed to settle, and this is easily accomplished in much less time than was required for the original clarification. A tank, 36 inches deep, gives about 34 inches of clear juice and 2 inches of settlings in about one hour. Attempts to filter the settlings or sediments were unsuccessful. The settlings from the lime and clay clarification, together with the settlings from the acid phosphate clarification should be run into a sirup tank, diluted with an equal volume of water and again allowed to settle and the clear liquor drawn off, by which means much of the waste which would otherwise occur can be avoided. By a proper arrangement of the swing valve the liquor can all be drawn off from the surface downward, and thus secure a complete separation of the settlings from the clear liquor. The clarified liquor can be easily filtered through fine cloths without pressure. Though filtering is not as necessary with clear and bright juice as it is with cloudy juice, yet it gives greater brightness to the molasses, by removing all the fine particles which escape subsidence in the ordinary way.

The clarified juice prepared in the manner above can be evaporated in any convenient way which the farmer and small manufacturer have at hand. It is only important that the evaporation should be rapid, and is best conducted in a thin film and in pans with several compartments with a continuous flow. An example of the method of the work may be seen from the following data:

September 29, tank No. 1 contained 480 gallons sorghum juice, which showed a total solid, by means of a Brix spindle, of 21 per cent. The juice was limed to slight alkalinity and clay batter added until the total solids as indicated by the spindle amounted to 22.5 per cent. The liquor was then allowed to settle for one hour and ten minutes, after which 440 gallons of clear juice were drawn off, and to this clear juice one gallon of acid phosphate of calcium was added, the temperature raised to the boiling point, and the mass skimmed. The whole was then allowed to settle for forty minutes, after which the clear juice was drawn off and filtered. The settling of the sediments required one hour. The skimmings were then mixed and diluted with water and resettled, giving a clear juice, showing 9 per cent total solids. The clear juice was then evaporated to molasses, giving a light-colored and fine-flavored product. No data of the yield per ton or per acre were obtained.

## ANALYTICAL DATA AT MEDICINE LODGE.

By Oma Carr.

Tables I and II, following, show the relative grading of the varieties according to their respective percentages of sucrose and the purity of their juices, based on analyses of canes examined for seed selection. The analyses cover the progeny of pedigreed ancestors. The total number of selections from pedigreed planting was 32,849, and from all kinds of parents, 49,912; so that the selections from plats planted in bulk seed number 17,063. The averages of 17.22 per cent sucrose and 76.5 purity accurately represent the seed-canes selected from pedigreed ancestors for all varieties planted in such seed.

Table I.—*Seed selections (from pedigreed ancestors)—Standing of varieties.*

| Rank. | Variety. | Sucrose in juice. | Number of selections. | Rank. | Variety. | Sucrose in juice. | Number of selections. |
|---|---|---|---|---|---|---|---|
| | | *Per cent.* | | | | *Per cent.* | |
| 1 | Collier | 18.99 | 5,506 | 9 | Colman | 15.79 | 6,553 |
| 2 | McLean | 18.42 | 2,193 | 10 | Folger | 15.53 | 2,255 |
| 3 | Link's Crosses | 18.36 | 610 | 11 | No. 160 | 15.05 | 2,302 |
| 4 | No. 112 | 17.20 | 1,621 | 12 | African | 15.04 | 2,587 |
| 5 | Link | 17.05 | 4,666 | | | | |
| 6 | Cross 8X | 16.75 | 1,893 | | Average | 17.22 | .......... |
| 7 | No. 161 | 16.56 | 1,289 | | Total | .......... | 32,849 |
| 8 | Planter | 16.00 | 2,374 | | | | |

Table II.—*Seed selections (from pedigreed ancestors)—Standing of varieties.*

| Rank. | Variety. | Purity of juice. | Number of selections. | Rank. | Variety. | Purity of juice. | Number of selections. |
|---|---|---|---|---|---|---|---|
| | | *Per cent.* | | | | *Per cent.* | |
| 1 | McLean | 77.99 | 2,193 | 8 | Planter | 72.95 | 2,374 |
| 2 | Collier | 77.13 | 5,506 | 9 | Folger | 72.20 | 2,255 |
| 3 | Link's Crosses | 77.04 | 610 | 10 | Colman | 72.10 | 6,553 |
| 4 | No. 160 | 76.00 | 2,302 | 11 | African | 69.18 | 2,587 |
| | No. 161 | 76.00 | 1,289 | | | | |
| 5 | Cross, 8 X | 75.40 | 1,893 | | Mean | 76.50 | .......... |
| 6 | No. 112 | 75.00 | 1,621 | | Total | .......... | 32,849 |
| 7 | Link | 74.09 | 4,666 | | | | |

Tables III and IV, following, show the grading of varieties, as determined by the mean of maximum sucroses and purities of average samples. Maximum sucroses and purities among the several periodical analyses of each plat were added together and averaged. The scale has only a partial value, because those varieties of which but one plat was planted furnish but one maximum, while others of which many plats were planted furnish a number of maxima. For instance, Early Orange, one plat, gives a single maximum of 79.8 purity, while McLean, a superior variety of which eleven plats were planted, gives only 78 purity; the difference being due to the number of maxima used in striking a mean in each case.

TABLE III.—*Average samples—Standing of varieties.*

| Grade. | Variety. | Sucrose in juice. | Number of maxima. | Grade. | Variety. | Sucrose in juice. | Number of maxima. |
|---|---|---|---|---|---|---|---|
| | | *Per cent.* | | | | *Per cent.* | |
| 1 | Collier | 19.39 | 7 | 7 | African | 17.47 | 3 |
| 2 | India and Orange | 18.10 | 1 | 8 | No. 112 | 17.40 | 1 |
| 3 | McLean | 18.06 | 13 | 9 | Colman | 17.16 | 6 |
| 4 | Planter | 17.90 | 3 | 10 | No. 289 | 17.00 | 1 |
| | Cross 8X | 17.90 | 1 | 11 | No. 160 | 16.75 | 1 |
| 5 | Orange | 17.70 | 1 | 12 | No. 161 | 16.30 | 2 |
| 6 | Link | 17.59 | 8 | 13 | Folger | 16.06 | 7 |

TABLE IV.—*Average samples—Standing of varieties.*

| Grade. | Variety. | Purity. | Number of maxima. | Grade. | Variety. | Purity. | Number of maxima. |
|---|---|---|---|---|---|---|---|
| | | *Per cent.* | | | | *Per cent.* | |
| 1 | Collier | 82.10 | 7 | 8 | Link | 77.90 | 8 |
| 2 | African | 81.20 | 3 | 9 | No. 289 | 77.50 | 1 |
| 3 | Cross 8X | 81.00 | 1 | 10 | Planter | 76.60 | 3 |
| 4 | No. 160 | 80.30 | 1 | 11 | No. 161 | 75.40 | 2 |
| 5 | Orange | 79.80 | 1 | 12 | Colman | 75.30 | 6 |
| 6 | India and Orange | 78.20 | 1 | 13 | Folger | 74.20 | 7 |
| 7 | McLean | 78.00 | 13 | | No. 112 | 74.20 | 1 |

Table V, following, is made up with the idea of determining the closeness with which a family may adhere to certain characteristics of an ancestor. For this purpose parent and progeny analyses are placed in contrast side by side.

In the work of seed selections an indefinite number of normal canes are selected in the field and of these only those are accepted whose juices exceed a certain density. They are thus what may be termed superior individuals of a family and may be reasonably compared with the ancestor, which was a superior individual in the preceding generation.

In the table the averages for the progeny represent from five to eighty times as many canes as the averages for the parents. In planting parent panicles 200 to 300 feet were allotted to each head and the row numbered. The analyses of canes taken from that row are averaged and compared with the analysis of the parent cane. In the table, 732 such parents have been compared with a progeny numbering 19,301 individuals, divided according to varieties and plats.

It is not anticipated that the whole number of individuals in a family will have characteristics or qualities equal or superior to those of a single ancestor. Were such the case, the task of improving a variety by selection would demand very little time and insignificant labor and expense. On the contrary, we consider that when a generation of canes is superior to the preceding generation, from which a superior ancestor was chosen, an advance has been made. At the same time, if a large number of individuals, selected at random, come close to the single ancestor in similarity of characteristics and qualities, the succeeding generation may be expected to surpass the preceding.

As an instance of progeny surpassing parent, Collier, block 47, is cited. In this case the numerical ratio of parent to progeny is 1:40.7; the percentage of purity increase is 3.97 and of sucrose increase 13.9.

A reverse instance is Colman, block 41. The numerical ratio of parent to progeny is 1:35; the percentage of purity decrease is 6.43, and the sucrose shows an increase of 1.71 per cent, due to a higher percentage of marc in progeny.

For all the varieties, on good and bad ground and under varying conditions of cultivation and harvesting, the progeny shows a slight decrease in purity equal to 1.98 per cent and a sucrose increase of 5.91 per cent.

It is fair to assume that the next generation of canes, springing from ancestors selected from among the superior individuals of this family, will surpass, as a whole, the generation preceding it.

TABLE V.—*Comparison of parent and progeny.*

| Variety. | Block. | Plat. | Average sucrose in juice. | | Average purity. | | Canes in progeny. | Parents. |
|---|---|---|---|---|---|---|---|---|
| | | | Parent, Sterling. | Progeny, Medicine Lodge. | Parent, Sterling. | Progeny, Medicine Lodge. | | |
| | | | *Per cent.* | *Per cent.* | | | | |
| Folger | 5 | 63 | 15.34 | 15.55 | 73.23 | 72.10 | 847 | 37 |
| | | 82 | 15.59 | 15.34 | 72.62 | 71.40 | 383 | 32 |
| | | 83 | 15.34 | 15.09 | 74.00 | 70.50 | 659 | 37 |
| Average | | | 15.31 | 15.53 | 73.14 | 72.20 | 1,879 | 106 |
| No. 160 | 89 | 88 | 15.50 | 17.99 | 73.00 | 76.00 | 274 | 9 |
| | | 89 | 16.30 | 17.80 | 74.30 | 76.60 | 59 | 2 |
| | | 90 | 15.55 | 17.04 | 73.40 | 73.50 | 331 | 4 |
| Average | | | 15.60 | 17.50 | 73.30 | 76.00 | 664 | 15 |
| No. 161 | 66 | 7 | 15.42 | 16.68 | 76.27 | 76.30 | 91 | 5 |
| | | 103 | 16.73 | 17.41 | 73.78 | 82.50 | 150 | 6 |
| | | 104 | 16.03 | 15.43 | 75.08 | 70.70 | 65 | 5 |
| Average | | | 16.10 | 16.56 | 74.34 | 76.00 | 306 | 16 |
| No. 112 | 73 | 12 | 15.58 | 17.41 | 73.30 | 73.80 | 884 | 12 |
| | | 85 | 14.94 | 17.17 | 74.13 | 76.10 | 540 | 13 |
| Average | | | 15.25 | 17.20 | 73.74 | 75.00 | 1,424 | 25 |
| Collier | 17 | 14 | 17.51 | 18.20 | 76.26 | 74.56 | 869 | 35 |
| | | 15 | 17.6 | 17.44 | 75.00 | 75.20 | 615 | 19 |
| | | 16 | 16.33 | 17.24 | 73.80 | 73.80 | 814 | 21 |
| Average | | | 17.17 | 17.70 | 75.28 | 74.76 | 2,298 | 75 |
| Collier | 47 | 11 | 17.15 | 19.27 | 78.70 | 75.80 | 395 | 9 |
| | | 23 | 17.50 | 20.13 | 74.91 | 78.85 | 1,598 | 40 |
| Average | | | 17.56 | 20.00 | 75.50 | 78.50 | 1,993 | 49 |
| Colman | 11 | 2 | 17.24 | 15.37 | 78.50 | 73.30 | 1,313 | 39 |
| | | 69 | 15.84 | 15.18 | 77.40 | 70.90 | 653 | 32 |
| | | 75 | 17.21 | 15.28 | 74.51 | 74.40 | 607 | 16 |
| Average | | | 16.45 | 15.35 | 77.30 | 72.54 | 2,573 | 87 |
| Colman | 41 | 61 | 15.65 | 16.62 | 77.41 | 72.40 | 247 | 11 |
| | | 68 | 16.37 | 16.56 | 78.83 | 71.90 | 90 | 3 |
| | | 70 | 17.66 | 15.81 | 77.26 | 73.50 | 369 | 7 |
| | | 76 | 15.80 | 16.62 | 74.50 | 75.50 | 46 | 2 |
| | | 77 | 15.22 | 15.77 | 74.80 | 69.60 | 671 | 13 |
| | | 78 | 14.84 | 15.34 | 73.27 | 70.00 | 169 | 7 |
| | | 80 | 15.90 | 16.35 | 75.66 | 73.50 | 189 | 8 |
| Average | | | 15.80 | 16.07 | 75.92 | 71.04 | 1,781 | 51 |
| McLean | 29 | 119 | 17.32 | 16.47 | 76.23 | 73.90 | 204 | 13 |
| | 58 | 113 | 17.50 | 18.73 | 76.00 | 78.50 | 793 | 40 |
| | 93 | 109 | 17.50 | 18.50 | 74.77 | 77.80 | 73 | 11 |
| | | 114 | 16.95 | 18.32 | 74.48 | 78.80 | 96 | 15 |
| Average | | | 17.26 | 18.40 | 74.60 | 78.40 | 166 | 26 |

TABLE V.—*Comparison of parent and progeny*—Continued.

| Variety. | Block. | Plat. | Averave sucrose in juice. | | Average purity. | | Canes in progeny. | Parents. |
|---|---|---|---|---|---|---|---|---|
| | | | Parent, Sterling. | Progeny, Medicine Lodge. | Parent, Sterling. | Progeny, Medicine Lodge. | | |
| | | | *Per cent.* | *Per cent.* | | | | |
| **Planter** | 76 | 57 | 17.32 | 15.82 | 75.21 | 72.20 | 201 | 9 |
| | | 59 | 17.00 | 16.32 | 78.54 | 73.60 | 250 | 5 |
| **Average** | | | 17.21 | 16.00 | 76.79 | 72.95 | 456 | 14 |
| **African** | 69 | 81 | 14.88 | 14.98 | 74.83 | 66.90 | 504 | 19 |
| | 75 | 91 | 15.83 | 15.28 | 77.80 | 69.50 | 253 | 21 |
| **Link's Crosses** | 61 | 18 | 15.32 | 18.19 | 71.80 | 76.80 | 1,026 | 32 |
| | | 48 | 16.43 | 19.11 | 75.80 | 79.10 | 131 | 4 |
| | | 51 | 15.30 | 18.21 | 71.10 | 77.00 | 126 | 4 |
| **Average** | | | 15.71 | 18.36 | 72.73 | 77.04 | 1,283 | 40 |
| **Link** | 23 | 4 | 16.82 | 16.40 | 75.15 | 70.50 | 250 | 33 |
| | | 32 | 14.30 | 16.85 | 74.00 | 71.70 | 392 | 38 |
| | | 42 | 15.78 | 17.50 | 72.34 | 73.50 | 224 | 11 |
| | | 44 | 15.88 | 17.10 | 72.60 | 74.00 | 204 | 14 |
| **Average** | | | 15.55 | 16.82 | 74.64 | 73.80 | 1,070 | 96 |
| | 49 | 49 | 16.10 | 16.47 | 73.40 | 71.00 | 1,174 | 34 |
| | 78 | 25 | 16.26 | 18.38 | 72.45 | 76.70 | 601 | 24 |
| | | 37 | 16.50 | 18.06 | 73.00 | 76.40 | 170 | 16 |
| **Average** | | | 16.35 | 18.19 | 72.60 | 77.20 | 771 | 40 |
| **Totals** | | | | | | | 19,301 | 732 |
| **Means for all varieties** | | | 16.08 | 17.03 | 75.70 | 74.20 | | |

Valuation of varieties according to their yield per acre and the price per ton as delivered to the factory is given for all the varieties planted at the Medicine Lodge Experiment Station, in Table VI. The season of 1892 having been rather unfavorable for yield, the valuations must not be accepted as the usual averages. It is proper to state, also, that the prices—scale of the Medicine Lodge Sugar Works Company—does not extend beyond 15 per cent sucrose and $2.30 per ton. Hence, Colman at 15 per cent has the same value per ton as variety No. 112 at 16.8 per cent, manifestly unfair in the comparison. The yield per acre is for topped cane, as delivered by the farmers to the factory, and comes from accurately surveyed plats.

TABLE VI.—*Valuation of varieties, on agricultural data.*

| Scale. | Variety. | Number of blocks. | Number of acres. | Total tons topped cane. | Tons topped cane per acre. | Average sucrose in juice. | Average price per ton. | Average revenue per acre. |
|---|---|---|---|---|---|---|---|---|
| | | | | | | *Per cent.* | | |
| 1 | Orange | 1 | 1.000 | 13.00 | 13.00 | 14.1 | $2.20 | $28.60 |
| 2 | Colman | 3 | 5.193 | 46.75 | 9.02 | 15.0 | 2.30 | 20.75 |
| 3 | No. 160 | 1 | 1.000 | 9.00 | 9.00 | 15.6 | 2.30 | 20.70 |
| 4 | Folger | 5 | 7.136 | 62.25 | 8.72 | 13.9 | 2.10 | 18.31 |
| 5 | Amber | 1 | 1.000 | 8.50 | 8.50 | 13.6 | 2.10 | 17.85 |
| 6 | Collier | 4 | 7.383 | 52.50 | 7.11 | 15.1 | 2.30 | 16.35 |
| 7 | Link | 5 | 5.813 | 40.60 | 6.98 | 15.7 | 2.30 | 16.05 |
| 8 | No. 161 | 2 | 2.000 | 18.25 | 6.63 | 16.8 | 2.30 | 15.25 |
| 9 | Variety No. 112 | 1 | 1.000 | 6.50 | 6.50 | 16.8 | 2.30 | 14.95 |
| 10 | India and Orange | 1 | 1.000 | 6.11 | 6.11 | 15.6 | 2.30 | 14.05 |
| 11 | African | 3 | 3,000 | 20.50 | 6.83 | 12.5 | 2.00 | 13.66 |
| 12 | Planter | 2 | 2.000 | 12.11 | 6.06 | 14.2 | 2.20 | 13.30 |
| 13 | McLean | 5 | 6.000 | 36.07 | 6.01 | 14.4* | 2.20 | 13.22 |
| | Total and mean | 34 | 43.525 | 327.14 | 7.52 | 14.2 | 2.20 | 16.53 |

* Low sucrose for McLean, due to several loads of frozen cane.

The total number of heads selected for propagation during the season of 1893, is as follows:

| | Number selected. | Number analyzed. |
|---|---|---|
| Pedigreed plats | 2,528 | 32,849 |
| Bulk-seed | 1,259 | 17,063 |
| Total | 3,787 | 49,912 |

It may be remarked from these figures that the care and labor necessary in the work of variety improvement is considerable, comprising the examination of over 50,000 superior canes, from which are ultimately selected only 3,787 or 7.5 per cent to continue the strain.

The tables are divided according to character of seed, pedigreed or bulk. It was deemed advisable to select liberally from the bulk-seed lots, as from these came some of our superior canes. Some varieties, too, were planted altogether in bulk, viz, No. 289, No. 8X, and India and Orange.

TABLE VII.—*Propagation heads for 1893, from pedigreed parents.*

| Variety. | Number selected heads. | Sucrose in juice. | Purity. | Variety. | Number selected heads. | Sucrose in juice. | Purity. |
|---|---|---|---|---|---|---|---|
| | | *Per cent.* | | | | *Per cent.* | |
| Amber | 194 | 16.39 | 81.93 | No. 112 | 100 | 17.91 | 80.80 |
| Folger | 516 | 16.18 | 77.40 | Link | 234 | 18.11 | 80.00 |
| No. 160 | 94 | 18.30 | 80.30 | Link's Crosses | 87 | 19.00 | 81.10 |
| No. 161 | 129 | 17.20 | 83.65 | Orange | 94 | 19.10 | 80.20 |
| Collier | 330 | 20.06 | 82.50 | African | 86 | 17.03 | 76.85 |
| McLean | 391 | 19.20 | 81.75 | | | | |
| Colman | 273 | 17.12 | 80.90 | Mean | 2,528 | 17.88 | 80.48 |

TABLE VIII.—*Propagation heads for 1893, from bulk-seed.*

| Variety. | Number selected heads. | Sucrose in juice. | Purity. | Variety. | Number selected heads. | Sucrose in juice. | Purity. |
|---|---|---|---|---|---|---|---|
| | | *Per cent.* | | | | *Per cent.* | |
| Collier: | | | | No. 289 | 66 | 17.70 | 80.64 |
| First choice | 392 | 19.39 | 81.50 | 8X | 101 | 18.51 | 81.07 |
| Second choice | 139 | 19.18 | 79.70 | India and Orange | 58 | 18.38 | 78.60 |
| Colman | 398 | 19.27 | 80.40 | | | | |
| Planter | 105 | 17.78 | 81.22 | Mean | 1,259 | 19.00 | 80.7 |

# ANALYTICAL DATA AT STERLING.

By J. L. Fuelling.

Regular work was commenced in the laboratory on August 20, upon such early varieties as had matured sufficiently to warrant selection. As there were but a few plats upon which work was possible at that time, we completed our selections upon them by the end of the first week. No others having matured by that time, selection work was discontinued for one week. After this delay work was resumed and continued with but an occasional interruption until the 1st of October.

In all 37,403 seed-selection analyses and 1,772 average analyses were made, giving us an average of 1,399 analyses per day. As approximately only 25 per cent of the canes were accepted and analyzed, after milling there were about 156,700 canes examined. In making the selections for propagation the canes undergo seven examinations before they are finally accepted. An average sample of the field is taken and analyzed. Should the analysis come up to the requirements the largest, healthiest, and most mature canes are cut and sent to the laboratory. They are then stripped of their leaves, and again only the largest and best canes are selected and milled. The juice is examined with a total solids spindle, and only those reaching a certain standard of density are examined by the polariscope and placed on record. At the completion of the season's work the individuals whose analyses show the highest sucrose and purity are selected, and from these final selections are made for propagation.

In studying Tables IX and XI, and comparing the relative standing of the various varieties of this year with similar varieties of last year, there is a noticeable divergency in some cases. It is particularly noticeable with the Colman variety. Last year Colman reached 11 per cent sucrose on August 30, whereas this year it did not reach this point until September 7. In actual time, however, from date of planting, there is only a difference of two days. Planter shows a difference of fourteen days less time than last year. The actual mean difference of all the varieties, as compared with last year, is nine days later than last year.

Table IX.—*Showing number of days required for each variety to reach 11 per cent sucrose.*

| Grade. | Name. | Days. | Grade. | Name. | Days. |
|---|---|---|---|---|---|
| 1 | India and Orange | 102 | 26 | Cross 110X | 143 |
| 2 | African | 103 | 27 | Variety 208 | 144 |
| 3 | Amber | 114 | 28 | Link | 144 |
| 4 | Koombana | 122 | 29 | Kansas Orange | 144 |
| 5 | Cross 5X | 131 | 30 | Cross 401X | 144 |
| 6 | Variety 491 | 131 | 31 | Cross 426X | 145 |
| 7 | Imphee | 133 | 32 | Cross 206X | 145 |
| 8 | Variety 289 | 134 | 33 | Cross 165X | 145 |
| 9 | Planter | 134 | 34 | Cross 6X | 146 |
| 10 | Ubehlana | 134 | 35 | Hottinger | 147 |
| 11 | Cross 292X | 134 | 36 | Seedless | 147 |
| 12 | Colman | 135 | 37 | Variety 112 | 148 |
| 13 | McLean | 135 | 38 | Cross 8X | 148 |
| 14 | Variety 227 | 136 | 39 | Cross 142X | 149 |
| 15 | Cross 14X | 137 | 40 | Cross 7X | 149 |
| 16 | Variety 161 | 137 | 41 | Cross 48X | 150 |
| 17 | Cross 15X | 138 | 42 | Cross 107X | 153 |
| 18 | Cross 592X | 138 | 43 | Cross 168X | 154 |
| 19 | Cross 180X | 139 | 44 | Cross 232X | 154 |
| 20 | Collier | 140 | 45 | Cross 43X | 159 |
| 21 | Cross 341X | 141 | 46 | Cross 187X | 159 |
| 22 | Orange | 141 | 47 | Cross 67X | 164 |
| 23 | Cross 42X | 142 | 48 | Cross 27X | 164 |
| 24 | Cross 23X | 142 | 49 | Cross 424X | 166 |
| 25 | Folger | 142 | 50 | Brown | 168 |

**TABLE X** —*Showing dates on which the various varieties reached 11 per cent sucrose, based on average samples.*

| Grade. | Name. | Date. | Grade. | Name. | Date. |
|---|---|---|---|---|---|
| 1 | Amber | Aug. 22 | 26 | Cross 206X | Sept. 6 |
| 2 | Cross 292X | Aug. 25 | 27 | Cross 426X | Sept. 6 |
| 3 | Variety 491 | Aug. 25 | 28 | Cross 592X | Sept. 6 |
| 4 | Imphee | Aug. 27 | 29 | Ubehlana | Sept. 7 |
| 5 | Cross 15X | Aug. 28 | 30 | Koombana | Sept. 7 |
| 6 | Variety 161 | Aug. 28 | 31 | Cross 110X | Sept. 7 |
| 7 | Folger | Aug. 29 | 32 | Colman | Sept. 7 |
| 8 | Cross 5X | Aug. 29 | 33 | India and Orange | Sept. 8 |
| 9 | McLean | Aug. 30 | 34 | Cross 165X | Sept. 8 |
| 10 | Planter | Aug. 30 | 35 | Kansas Orange | Sept. 8 |
| 11 | Cross 180X | Aug. 30 | 36 | Cross 7X | Sept. 10 |
| 12 | Variety 227 | Sept. 1 | 37 | Cross 142X | Sept. 10 |
| 13 | Cross 14X | Sept. 1 | 38 | Cross 48X | Sept. 14 |
| 14 | Variety 112 | Sept. 2 | 39 | Cross 6X | Sept. 14 |
| 15 | Variety 289 | Sept. 3 | 40 | Cross 107X | Sept. 14 |
| 16 | Cross 42X | Sept. 4 | 41 | Seedless | Sept. 14 |
| 17 | African | Sept. 5 | 42 | Cross 232X | Sept. 15 |
| 18 | Orange | Sept. 5 | 43 | Cross 168X | Sept. 15 |
| 19 | Link | Sept. 5 | 44 | Hottinger | Sept. 20 |
| 20 | Collier | Sept. 5 | 45 | Cross 187X | Sept 20 |
| 21 | Cross 341X | Sept. 5 | 46 | Cross 43X | Sept. 20 |
| 22 | Cross 401X | Sept. 5 | 47 | Brown | Sept. 21 |
| 23 | Cross 23X | Sept. 5 | 48 | Cross 27X | Sept. 25 |
| 24 | Cross 8X | Sept. 5 | 49 | Cross 67X | Sept. 25 |
| 25 | Variety 208X | Sept. 5 | 50 | Cross 424X | Sept. 27 |

The greatest divergency which we notice in Tables XI and XII, as compared with last year's work, was with India and Orange, this variety being thirty days earlier this year. Differences are noticeable in almost all the earlier varieties, extending from fifteen to thirty days. So great a difference in time of ripening can not be attributed wholly to earlier selections, but must, in part, be due to climatic conditions. The mean difference, as compared to last year, shows that the varieties were ten days earlier this year in reaching a purity of 70, while, as before noted, they were later in reaching a content of 11 per cent sucrose.

**TABLE XI.**—*Showing number of days required for each variety to reach a purity of 70 per cent.*

| Grade. | Name. | Days. | Grade. | Name. | Days. |
|---|---|---|---|---|---|
| 1 | African | 108 | 25 | Cross 165X | 147 |
| 2 | India and Orange | 110 | 26 | Planter | 148 |
| 3 | Amber | 114 | 27 | Cross 23X | 148 |
| 4 | Variety 491 | 129 | 28 | Cross 424X | 149 |
| 5 | Cross 292X | 134 | 29 | Cross 206X | 149 |
| 6 | Cross 5X | 134 | 30 | Cross 107X | 149 |
| 7 | Colman | 135 | 31 | Cross 7X | 149 |
| 8 | Imphee | 136 | 32 | Folger | 149 |
| 9 | Cross 592X | 136 | 33 | Cross 426X | 149 |
| 10 | Cross 14X | 139 | 34 | Cross 15X | 149 |
| 11 | McLean | 139 | 35 | Cross 8X | 151 |
| 12 | Cross 401X | 140 | 36 | Cross 48X | 151 |
| 13 | Variety 227 | 141 | 37 | Orange | 151 |
| 14 | Variety 161 | 142 | 38 | Hottinger | 153 |
| 15 | Brown | 142 | 39 | Cross 168X | 154 |
| 16 | Variety 289 | 143 | 40 | Cross 27X | 154 |
| 17 | Cross 110X | 143 | 41 | Seedless | 155 |
| 18 | Link | 144 | 42 | Variety 208 | 155 |
| 19 | Cross 42X | 144 | 43 | Cross 180X | 156 |
| 20 | Collier | 144 | 44 | Ubehlana | 158 |
| 21 | Cross 142X | 145 | 45 | Cross 187X | 159 |
| 22 | Cross 6X | 146 | 46 | Cross 43X | 159 |
| 23 | Kansas Orange | 146 | 47 | Variety 112 | 160 |
| 24 | Cross 341X | 147 | 48 | Cross 67X | 170 |

**TABLE XII.**—*Showing dates at which the various varieties reached a purity of 70, based on average samples.*

| Grade. | Name. | Dates. | Grade. | Name. | Dates. |
|---|---|---|---|---|---|
| 1 | Variety 491 | Aug. 25 | 26 | Cross 107X | Sept. 10 |
| 2 | Cross 292X | Aug. 25 | 27 | Cross 165X | Sept. 10 |
| 3 | Amber | Aug. 30 | 28 | Kansas Orange | Sept. 10 |
| 4 | Imphee | Aug. 30 | 29 | Cross 341X | Sept. 11 |
| 5 | Cross 401X | Sept. 1 | 30 | Cross 23X | Sept. 11 |
| 6 | Brown | Sept. 2 | 31 | Folger | Sept. 12 |
| 7 | Cross 5X | Sept. 2 | 32 | Variety 208 | Sept. 12 |
| 8 | Cross 14X | Sept. 3 | 33 | Variety 289 | Sept. 12 |
| 9 | Variety 161 | Sept. 3 | 34 | Planter | Sept. 14 |
| 10 | McLean | Sept. 4 | 35 | Cross 6X | Sept. 14 |
| 11 | Cross 592X | Sept. 4 | 36 | Variety 112 | Sept. 14 |
| 12 | Link | Sept. 5 | 37 | Cross 48X | Sept. 15 |
| 13 | Variety 227 | Sept. 6 | 38 | Cross 27X | Sept. 15 |
| 14 | Cross 42X | Sept. 6 | 39 | Orange | Sept. 15 |
| 15 | Cross 142X | Sept. 6 | 40 | Cross 168X | Sept. 15 |
| 16 | Cross 110X | Sept. 7 | 41 | India and Orange | Sept. 16 |
| 17 | Colman | Sept. 7 | 42 | Cross 180X | Sept. 17 |
| 18 | Cross 8X | Sept. 8 | 43 | Cross 187X | Sept. 20 |
| 19 | Cross 15X | Sept. 9 | 44 | Cross 43X | Sept. 20 |
| 20 | Collier | Sept. 9 | 45 | Seedless | Sept. 23 |
| 21 | African | Sept. 10 | 46 | Hottinger | Sept. 26 |
| 22 | Cross 426X | Sept. 10 | 47 | Cross 67X | Oct. 1 |
| 23 | Cross 206X | Sept. 10 | 48 | Ubehlana | Oct. 1 |
| 24 | Cross 424 | Sept. 10 | 49 | Koombana | Never. |
| 25 | Cross 7X | Sept. 10 | 50 | Cross 232X | Never. |

In Tables XIII and XIV we find the mean sucroses of all the maximum sucroses found in any one variety, by an average analysis, and the dates, obtained in a similar manner, upon which the varieties reach their maximum sucrose. For a comparison of this year's results with those of past years, see Table XXI.

**TABLE XIII.**—*Showing the relative value and position as based on the analysis of average samples with maximum sucrose per cent in juice.*

| Grade. | Name. | Sucrose | Grade. | Name. | Sucrose. |
|---|---|---|---|---|---|
| | | *Per cent.* | | | *Per cent.* |
| 1 | Collier | 18.50 | 26 | Variety 491 | 15.80 |
| 2 | India and Orange | 18.10 | 27 | Variety 227 | 15.80 |
| 3 | Orange | 17.49 | 28 | Cross 23 X | 15.77 |
| 4 | McLean | 17.24 | 29 | Seedless | 15.75 |
| 5 | Cross 7X | 17.30 | 30 | Cross 6 X | 15.70 |
| 6 | Planter | 17.02 | 31 | Kansas Orange | 15.60 |
| 7 | Colman | 16.93 | 32 | Cross 142 X | 15.60 |
| 8 | Imphee | 16.90 | 33 | Folger | 15.57 |
| 9 | Cross 592X | 16.88 | 34 | Variety 289 | 15.56 |
| 10 | Variety 161 | 16.84 | 35 | Cross 48 X | 15.40 |
| 11 | Cross 14X | 16.84 | 36 | Cross 180 X | 15.27 |
| 12 | African | 16.72 | 37 | Cross 165 X | 14.92 |
| 13 | Ubehlana | 16.70 | 38 | Hottinger | 14.85 |
| 14 | Cross 341X | 16.60 | 39 | Cross 426 X | 14.80 |
| 15 | Cross 292X | 16.50 | 40 | Cross 206 X | 14.70 |
| 16 | Cross 42X | 16.46 | 41 | Amber | 14.50 |
| 17 | Cross 8X | 16.45 | 42 | Cross 424 X | 14.30 |
| 18 | Cross 110X | 16.40 | 43 | Cross 168 X | 14.10 |
| 19 | Cross 15X | 16.30 | 44 | Cross 43 X | 13.60 |
| 20 | Variety 208 | 16.29 | 45 | Koombana | 13.30 |
| 21 | Variety 112 | 16.11 | 46 | Cross 67 X | 12.70 |
| 22 | Cross 107X | 16.00 | 47 | Brown | 12.60 |
| 23 | Cross 401X | 16.00 | 48 | Cross 27 X | 12.10 |
| 24 | Link | 15.99 | 49 | Cross 232 X | 11.60 |
| 25 | Cross 5X | 15.97 | 50 | Cross 187 X | 10.90 |

**TABLE XIV.**—*Showing dates at which the various varieties reached their maximum sucrose per cent in juice, based on average samples.*

| Grade. | Name. | Date. | Grade. | Name. | Date. |
|---|---|---|---|---|---|
| 1 | Cross 27X | Sept. 14 | 26 | African | Oct. 1 |
| 2 | Cross 5X | Sept. 26 | 27 | Variety 208 | Oct. 1 |
| 3 | Cross 401X | Sept. 27 | 28 | Planter | Oct. 1 |
| 4 | Cross 426X | Sept. 27 | 29 | Cross 289X | Oct. 1 |
| 5 | Cross 168X | Sept. 27 | 30 | Hottinger | Oct. 1 |
| 6 | Cross 424X | Sept. 27 | 31 | Brown | Oct. 1 |
| 7 | Cross 489X | Sept. 27 | 32 | Cross 142X | Oct. 1 |
| 8 | Folger | Sept. 28 | 33 | Cross 107X | Oct. 1 |
| 9 | McLean | Sept. 28 | 34 | Cross 232X | Oct. 1 |
| 10 | Amber | Sept. 29 | 35 | Cross 67X | Oct. 1 |
| 11 | Colman | Sept. 29 | 36 | Cross 187X | Oct. 1 |
| 12 | Cross 341X | Sept. 29 | 37 | Cross 43X | Oct. 1 |
| 13 | Cross 180X | Sept. 29 | 38 | Cross 23X | Oct. 1 |
| 14 | Cross 165X | Sept. 29 | 39 | Cross 8X | Oct. 2 |
| 15 | Variety 161 | Sept. 29 | 40 | Cross 42X | Oct. 3 |
| 16 | Collier | Sept. 30 | 41 | Cross 48X | Oct. 3 |
| 17 | Seedless | Sept. 30 | 42 | Variety 227 | Oct. 3 |
| 18 | Variety 112 | Sept. 30 | 43 | Kansas Orange | Oct. 3 |
| 19 | Orange | Sept. 30 | 44 | Imphee | Oct. 3 |
| 20 | Link | Sept. 30 | 45 | Cross 6X | Oct. 4 |
| 21 | Cross 14X | Sept. 30 | 46 | Cross 592X | Oct. 4 |
| 22 | Cross 110X | Sept. 30 | 47 | Ubehlana | Oct. 5 |
| 23 | Cross 206X | Sept. 30 | 48 | Koombana | Oct. 5 |
| 24 | Variety 289 | Sept. 31 | 49 | India and Orange | Oct. 6 |
| 25 | Cross 15X | Sept. 31 | | | |

In Tables XV and XVI are found the mean glucose per cents of all the minimum glucose per cents found in any one variety, by an average analysis, and the dates obtained in a similar manner, upon which the varieties reached their minimum glucose per cents. For a comparison of this year's results with those of past years, see Table XXVII.

**TABLE XV.**—*Showing the relative value and position of various varieties, with minimum glucose per cent in juice, based on average samples.*

| Grade. | Name. | Glucose. | Grade. | Name. | Glucose. |
|---|---|---|---|---|---|
| | | *Per cent.* | | | *Per cent.* |
| 1 | Cross 232X | 0.22 | 26 | Seedless | 0.68 |
| 2 | Cross 142X | 0.24 | 27 | Variety 112 | 0.69 |
| 3 | Cross 168X | 0.24 | 28 | Cross 292X | 0.69 |
| 4 | Cross 206X | 0.27 | 29 | Variety 297 | 0.69 |
| 5 | Imphee | 0.32 | 30 | Hottinger | 0.73 |
| 6 | Cross 424X | 0.32 | 31 | Koombana | 0.80 |
| 7 | Cross 426X | 0.32 | 32 | Planter | 0.81 |
| 8 | Cross 165X | 0.43 | 33 | Cross 107X | 0.81 |
| 9 | Cross 14X | 0.43 | 34 | Cross 180X | 0.83 |
| 10 | Variety 161 | 0.44 | 35 | Cross 187X | 0.86 |
| 11 | McLean | 0.47 | 36 | Variety 491 | 0.87 |
| 12 | Cross 341X | 0.49 | 37 | Cross 27X | 0.89 |
| 13 | Cross 8X | 0.49 | 38 | Cross 401X | 0.89 |
| 14 | Collier | 0.49 | 39 | Folger | 0.91 |
| 15 | Colman | 0.50 | 40 | Orange | 0.92 |
| 16 | Cross 43X | 0.51 | 41 | Cross 5X | 0.93 |
| 17 | Cross 15X | 0.54 | 42 | Cross 67X | 0.94 |
| 18 | Cross 42X | 0.56 | 43 | Variety 289 | 0.95 |
| 19 | Link | 0.58 | 44 | India and Orange | 0.96 |
| 20 | Cross 23X | 0.59 | 45 | Brown | 0.96 |
| 21 | Amber | 0.60 | 46 | Cross 7X | 1.10 |
| 22 | Cross 592X | 0.63 | 47 | Ubehlana | 1.13 |
| 23 | Cross 110X | 0.65 | 48 | Cross 6X | 1.45 |
| 24 | Variety 208 | 0.65 | 49 | Cross 48X | 1.52 |
| 25 | African | 0.67 | | | |

**TABLE XVI.**—*Showing dates at which various varieties reached their minimum glucose per cent in juice, based on average samples.*

| Grade. | Name. | Date. | Grade. | Name. | Date. |
|---|---|---|---|---|---|
| 1 | Cross 67X | Sept. 20 | 26 | Variety 289 | Sept. 30 |
| 2 | Cross 165X | Sept. 23 | 27 | Orange | Sept. 30 |
| 3 | Cross 180X | Sept. 24 | 28 | Seedless | Sept. 30 |
| 4 | Cross 341X | Sept. 24 | 29 | Cross 15X | Sept. 30 |
| 5 | Colman | Sept. 25 | 30 | Cross 142X | Oct. 1 |
| 6 | Cross 7X | Sept. 26 | 31 | Cross 232X | Oct. 1 |
| 7 | African | Sept. 26 | 32 | Planter | Oct. 1 |
| 8 | McLean | Sept. 26 | 33 | Cross 292X | Oct. 1 |
| 9 | Variety 227 | Sept. 27 | 34 | Cross 206X | Oct. 1 |
| 10 | Folger | Sept. 27 | 35 | Cross 168X | Oct. 1 |
| 11 | Cross 8X | Sept. 27 | 36 | Cross 43X | Oct. 1 |
| 12 | Cross 107X | Sept. 27 | 37 | Cross 5X | Oct. 3 |
| 13 | Brown | Sept. 27 | 38 | Cross 48X | Oct. 3 |
| 14 | Cross 426X | Sept. 27 | 39 | Variety 161 | Oct. 3 |
| 15 | Cross 27X | Sept. 27 | 40 | Variety 491 | Oct. 3 |
| 16 | Link | Sept. 28 | 41 | Cross 424X | Oct. 3 |
| 17 | Collier | Sept. 28 | 42 | Imphee | Oct. 3 |
| 18 | Cross 14X | Sept. 28 | 43 | Cross 592X | Oct. 3 |
| 19 | Variety 112 | Sept. 28 | 44. | Cross 6X | Oct. 4 |
| 20 | Cross 23X | Sept. 28 | 45 | Variety 208 | Oct. 4 |
| 21 | Cross 401X | Sept. 28 | 46 | Koombana | Oct. 5 |
| 22 | Hottinger | Sept. 28 | 47 | Cross 187X | Oct. 5 |
| 23 | Amber | Sept. 29 | 48 | Ubehlana | Oct. 5 |
| 24 | Cross 14X | Sept. 30 | 49 | India and Orange | Oct. 6 |
| 25 | Cross 110X | Sept. 30 | | | |

In Tables XVII and XVIII are recorded the mean purities of all the maximum purities found in any one variety, by an average analysis, and the dates obtained in a similar manner, upon which the varieties reached their maximum purity. For a comparison of this year's results with those of past years, see Table XXII.

**TABLE XVII.**—*Showing the relative value and position of various varieties with maximum purity of juice, based on average samples.*

| Grade. | Name. | Purity of juice. | Grade. | Name. | Purity of juice. |
|---|---|---|---|---|---|
| 1 | India and Orange | 78.40 | 26 | Amber | 75.50 |
| 2 | Cross 292X | 78.20 | 27 | Cross 8X | 75.33 |
| 3 | Collier | 78.19 | 28 | Seedless | 74.90 |
| 4 | Cross 341X | 78.00 | 29 | Variety 289 | 74.89 |
| 5 | Colman | 77.95 | 30 | Folger | 74.75 |
| 6 | Cross 592X | 77.82 | 31 | Variety 227 | 74.60 |
| 7 | Variety 161 | 77.79 | 32 | Cross 110X | 74.47 |
| 8 | Cross 42X | 77.71 | 33 | Cross 165X | 74.20 |
| 9 | Cross 5X | 77.33 | 34 | Cross 23X | 74.20 |
| 10 | Variety 208 | 77.16 | 35 | Cross 426X | 74.10 |
| 11 | Cross 401X | 77.10 | 36 | Cross 424X | 74.10 |
| 12 | Variety 491 | 77.10 | 37 | Cross 206X | 73.90 |
| 13 | Cross 7X | 77.00 | 38 | Cross 168X | 73.10 |
| 14 | Ubehlana | 77.00 | 39 | Cross 180X | 72.03 |
| 15 | Imphee | 76.90 | 40 | Link | 71.90 |
| 16 | McLean | 76.80 | 41 | Cross 48X | 71.60 |
| 17 | Orange | 76.71 | 42 | Cross 187X | 71.20 |
| 18 | Cross 15X | 76.54 | 43 | Cross 43X | 70.80 |
| 19 | Cross 142X | 76.50 | 44 | Cross 67X | 70.60 |
| 20 | Variety 112 | 76.37 | 45 | Hottinger | 70.42 |
| 21 | Planter | 76.36 | 46 | Cross 27X | 69.20 |
| 22 | Cross 107X | 76.20 | 47 | Brown | 69.40 |
| 23 | Cross 14X | 76.20 | 48 | Koombana | 69.20 |
| 24 | Cross 6X | 76.20 | 49 | Cross 232X | 67.10 |
| 25 | African | 75.60 | | | |

**TABLE XVIII.**—*Showing dates at which the various varieties reached their maximum purity of juice, based on average samples.*

| Grade. | Name. | Date. | Grade. | Name. | Date. |
|---|---|---|---|---|---|
| 1 | Cross 27X | Sept. 2 | 26 | Cross 341X | Sept. 30 |
| 2 | Koombana | Sept. 15 | 27 | Cross 206X | Sept. 30 |
| 3 | Cross 232X | Sept. 20 | 28 | Cross 110X | Sept. 30 |
| 4 | Cross 426X | Sept. 20 | 29 | Variety 112 | Sept. 30 |
| 5 | McLean | Sept. 22 | 30 | Cross 15X | Sept. 31 |
| 6 | Cross 14X | Sept. 25 | 31 | Variety 208 | Oct. 1 |
| 7 | Brown | Sept. 26 | 32 | Planter | Oct. 1 |
| 8 | Orange | Sept. 26 | 33 | Cross 43X | Oct. 1 |
| 9 | Cross 7X | Sept. 26 | 34 | Cross 67X | Oct. 1 |
| 10 | Cross 168X | Sept. 27 | 35 | Cross 107X | Oct. 1 |
| 11 | Collier | Sept. 27 | 36 | Cross 142X | Oct. 1 |
| 12 | Cross 424X | Sept. 27 | 37 | Cross 165X | Oct. 1 |
| 13 | Variety 227 | Sept. 27 | 38 | Cross 187X | Oct. 1 |
| 14 | Folger | Sept. 27 | 39 | Cross 292X | Oct. 1 |
| 15 | Link | Sept. 27 | 40 | Cross 42X | Oct. 2 |
| 16 | Colman | Sept. 27 | 41 | Cross 592X | Oct. 3 |
| 17 | Cross 180X | Sept. 27 | 42 | Variety 491 | Oct. 3 |
| 18 | Cross 5X | Sept. 27 | 43 | Cross 401X | Oct. 3 |
| 19 | Cross 23X | Sept. 28 | 44 | Imphee | Oct. 3 |
| 20 | Cross 8X | Sept. 28 | 45 | Cross 48X | Oct. 3 |
| 21 | Amber | Sept. 29 | 46 | Hottinger | Oct. 3 |
| 22 | African | Sept. 29 | 47 | Cross 6X | Oct. 3 |
| 23 | Variety 161 | Sept. 29 | 48 | Ubehlana | Oct. 5 |
| 24 | Seedless | Sept. 30 | 49 | India and Orange | Oct. 6 |
| 25 | Variety 289 | Sept. 30 | | | |

In Table XIX we find the mean sucrose of the canes selected from this year's work and intended for propagation next year.

**TABLE XIX.**—*Showing the relative value and position of seed selected varieties as based on the mean sucrose per cent in juice.*

| Grade. | Name. | Sucrose. | Grade. | Name. | Sucrose. |
|---|---|---|---|---|---|
| | | *Per cent.* | | | *Per cent.* |
| 1 | Collier | 18.43 | 14 | Cross 8X | 16.32 |
| 2 | Orange | 17.99 | 15 | Kansas Orange | 16.12 |
| 3 | Colman | 17.79 | 16 | Variety 289 | 16.06 |
| 4 | Cross 14X | 17.74 | 17 | Imphee | 15.55 |
| 5 | Variety 208 | 17.65 | 18 | Golden Orange | 15.20 |
| 6 | Cross 42X | 17.63 | 19 | Folger | 14.87 |
| 7 | Planter | 17.40 | 20 | Cross 15X | 14.86 |
| 8 | Variety 592 | 17.34 | 21 | Variety 161 | 14.67 |
| 9 | Seedless | 17.17 | 22 | Variety 160 | 14.20 |
| 10 | Cross 5X | 16.97 | 23 | Cross 180X | 14.05 |
| 11 | McLean | 16.92 | 24 | Amber | 13.94 |
| 12 | Variety 292 | 16.80 | 25 | Brown | 12.33 |
| 13 | Link | 16.49 | | | |

In Table XX are found the mean purities of the canes selected from this years' work and intended for propagation next year.

**TABLE XX.**—*Showing the relative position and value of seed selected varieties as based on the mean purity of their juice.*

| Grade. | Name. | Purity of juice. | Grade. | Name. | Purity of juice. |
|---|---|---|---|---|---|
| 1 | Variety 208 | 78.13 | 14 | Seedless | 75.43 |
| 2 | Colman | 77.99 | 15 | Variety 289 | 75.11 |
| 3 | McLean | 77.47 | 16 | Cross 14X | 74.87 |
| 4 | Orange | 77.39 | 17 | Variety 161 | 74.68 |
| 5 | Variety 292 | 77.25 | 18 | Amber | 73.65 |
| 6 | Variety 592 | 76.91 | 19 | Folger | 72.88 |
| 7 | Cross 42X | 76.72 | 20 | Cross 15X | 72.67 |
| 8 | Cross 5X | 76.12 | 21 | Imphee | 72.53 |
| 9 | Kansas Orange | 76.07 | 22 | Variety 160 | 72.01 |
| 10 | Collier | 76.02 | 23 | Golden Orange | 71.08 |
| 11 | Planter | 75.76 | 24 | Cross 180X | 70.62 |
| 12 | Link | 75.65 | 25 | Brown | 66.70 |
| 13 | Cross 8X | 75.59 | | | |

In the following tables are given the mean sucroses, glucoses, and purities of all the maximum sucroses and purities, and the minimum glucoses found in any one variety, determined by average analysis. They also show their relative standing and value for the past five years, and their mean position for that period.

TABLE XXI.—*Showing the relative value and position of varieties for the past five years, based on the mean of their maximum sucrose.*

| Variety. | 1888. | | 1889. | | 1890. | | 1891. | | 1892. | | Mean sucrose for the past five years. | Mean position for five years. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Relative position. | Sucrose. | Relative position. | Sucrose. | Relative position. | Sucrose. | Relative position. | Sucrose. | Relative position. | Sucrose. | | |
| | | *Per ct.* | | *Per ct.* | | *Per ct.* | | *Per ct.* | | *Per ct.* | *Per ct.* | |
| McLean | 0 | 0 | 0 | 0 | 4 | 15.22 | 1 | 16.40 | 3 | 17.24 | 16.28 | 1 |
| Colman | 0 | 0 | 6 | 14.58 | 6 | 14.88 | 4 | 15.60 | 5 | 16.93 | 15.49 | 2 |
| Variety 208 | 0 | 0 | 5 | 14.78 | 5 | 15.16 | 5 | 15.04 | 11 | 16.29 | 15.32 | 3 |
| Collier | 3 | 12.31 | 4 | 14.91 | 1 | 15.95 | 8 | 14.80 | 1 | 18.50 | 15.29 | 4 |
| Variety 289 | 0 | 0 | 2 | 15.47 | 3 | 15.69 | 14 | 14.10 | 15 | 15.56 | 15.20 | 5 |
| African | 0 | 0 | 9 | 14.24 | 19 | 13.36 | 9 | 14.80 | 8 | 16.72 | 14.78 | 6 |
| Planter | 4 | 12.15 | 7 | 14.43 | 7 | 14.47 | 3 | 15.80 | 4 | 17.02 | 14.77 | 7 |
| Cross 110X | 0 | 0 | 8 | 14.25 | 10 | 13.89 | 12 | 14.50 | 10 | 16.40 | 14.76 | 8 |
| Variety 112 | 0 | 0 | 9 | 14.23 | 14 | 13.55 | 6 | 15.00 | 12 | 16.11 | 14.72 | 9 |
| Imphee | 0 | 0 | 13 | 13.81 | 9 | 14.03 | 15 | 14.10 | 6 | 16.90 | 14.71 | 10 |
| Variety 161 | 0 | 0 | 14 | 13.24 | 9 | 14.03 | 11 | 14.60 | 7 | 16.84 | 14.68 | 11 |
| Link | 2 | 13.02 | 3 | 15.16 | 18 | 13.37 | 7 | 14.85 | 13 | 15.99 | 14.48 | 12 |
| Ubehlana | 1 | 13.10 | 20 | 12.03 | 22 | 12.51 | 21 | 13.00 | 9 | 16.70 | 13.47 | 13 |
| Orange | 6 | 10.40 | 18 | 12.12 | 16 | 13.50 | 18 | 13.60 | 2 | 17.49 | 13.42 | 14 |
| Folger | 7 | 10.66 | 20 | 11.92 | 8 | 14.12 | 10 | 14.60 | 14 | 15.57 | 13.37 | 15 |
| Amber | 9 | 9.50 | 21 | 11.69 | 20 | 12.84 | 23 | 12.90 | 16 | 14.50 | 12.28 | 16 |

TABLE XXII.—*Showing the relative value and position of varieties for the past five years, based on the mean of their minimum glucoses.*

| Variety. | 1888. | | 1889. | | 1890. | | 1891. | | 1892. | | Mean glucose in juice for the past five years. | Mean position for the past five years. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Relative position. | Glucose in juice. | Relative position. | Glucose in juice. | Relative position. | Glucose in juice. | Relative position. | Glucose in juice. | Relative position. | Glucose in juice. | | |
| | | *Per ct.* | | *Per ct.* | | *Per ct.* | | *Per ct.* | | *Per ct.* | *Per ct.* | |
| McLean | 0 | 0 | 0 | 0 | 1 | 0.52 | 1 | 0.55 | 3 | 0.47 | 0.51 | 1 |
| Variety 161 | 0 | 0 | 1 | 0.45 | 4 | 0.67 | 4 | 0.81 | 2 | 0.44 | 0.59 | 2 |
| Imphee | 0 | 0 | 4 | 0.61 | 5 | 0.73 | 15 | 1.10 | 1 | 0.32 | 0.69 | 3 |
| Collier | 1 | 0.73 | 6 | 0.75 | 2 | 0.59 | 8 | 0.90 | 4 | 0.49 | 0.69 | 4 |
| Cross 110X | 0 | 0 | 7 | 0.76 | 9 | 0.94 | 2 | 0.62 | 8 | 0.65 | 0.74 | 5 |
| Colman | 0 | 0 | 13 | 1.15 | 6 | 0.84 | 3 | 0.73 | 5 | 0.56 | 0.82 | 6 |
| Link | 3 | 1.06 | 6 | 0.65 | 13 | 1.15 | 6 | 0.83 | 6 | 0.58 | 0.86 | 7 |
| Variety 208 | 0 | 0 | 9 | 0.95 | 8 | 0.89 | 11 | 0.97 | 9 | 0.65 | 0.86 | 8 |
| Variety 289 | 0 | 0 | 3 | 0.59 | 6 | 0.84 | 16 | 1.18 | 15 | 0.95 | 0.89 | 9 |
| African | 0 | 0 | 8 | 0.81 | 16 | 1.32 | 18 | 1.25 | 10 | 0.67 | 1.01 | 10 |
| Variety 112 | 0 | 0 | 11 | 1.08 | 13 | 1.73 | 13 | 0.74 | 11 | 0.69 | 1.06 | 11 |
| Planter | 5 | 1.78 | 15 | 1.47 | 21 | 1.88 | 12 | 1.00 | 12 | 0.81 | 1.39 | 12 |
| Folger | 6 | 1.88 | 18 | 1.74 | 21 | 1.75 | 19 | 1.35 | 13 | 0.91 | 1.53 | 13 |
| Amber | 9 | 2.35 | 14 | 1.25 | 18 | 1.05 | 20 | 1.53 | 7 | 0.60 | 1.56 | 14 |
| Ubehlana | 0 | 0 | 19 | 2.25 | 23 | 2.52 | 21 | 1.54 | 16 | 1.13 | 1.86 | 15 |
| Orange | 10 | 2.80 | 20 | 2.52 | 22 | 2.15 | 23 | 2.24 | 14 | 0.92 | 2.13 | 16 |

**Table XXIII.**—*Showing the relative value and position of varieties for the past five years based on the mean of their maximum purities.*

| Variety. | 1888. |  | 1889. |  | 1890. |  | 1891. |  | 1892. |  | Mean purity of juice for five years. | Mean position for five years. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
|  | Relative position. | Purity of juice. | Relative position. | Purity of juice. | Relative position. | Purity of juice. | Relative position. | Purity of juice. | Relative position. | Purity of juice. |  |  |
|  |  | *Per ct.* |  | *Per ct.* |  | *Per ct.* |  | *Per ct.* |  | *Per ct.* | *Per ct.* |  |
| McLean | 0 | 0 | 0 | 0 | 4 | 76.80 | 1 | 77.40 | 6 | 76.80 | 77.00 | 1 |
| No. 208 | 0 | 0 | 4 | 77.76 | 1 | 77.70 | 6 | 74.40 | 3 | 77.16 | 76.76 | 2 |
| No. 161 | 0 | 0 | 6 | 77.33 | 4 | 75.92 | 5 | 74.80 | 2 | 77.79 | 76.46 | 3 |
| No. 289 | 0 | 0 | 2 | 79.74 | 2 | 76.47 | 14 | 72.35 | 13 | 74.89 | 75.86 | 4 |
| No. 112 | 0 | 0 | 7 | 76.42 | 10 | 74.75 | 9 | 73.70 | 9 | 76.37 | 75.31 | 5 |
| Colman | 0 | 0 | 12 | 75.55 | 5 | 76.38 | 2 | 76.30 | 15 | 77.95 | 75.29 | 6 |
| Collier | 2 | 71.69 | 7 | 76.95 | 9 | 74.73 | 9 | 73.80 | 1 | 78.20 | 75.07 | 7 |
| Imphee | 0 | 0 | 9 | 76.38 | 7 | 74.90 | 21 | 69.00 | 5 | 76.90 | 74.29 | 8 |
| African | 0 | 0 | 10 | 76.32 | 19 | 70.73 | 10 | 73.70 | 11 | 75.60 | 74.09 | 9 |
| Link | 1 | 72.09 | 3 | 79.00 | 16 | 71.77 | 11 | 73.35 | 16 | 71.90 | 73.62 | 10 |
| Folger | 5 | 68.24 | 14 | 73.15 | 6 | 74.91 | 12 | 73.30 | 14 | 74.75 | 72.87 | 11 |
| Planter | 7 | 65.39 | 11 | 76.06 | 18 | 71.49 | 4 | 75.08 | 10 | 76.36 | 72.87 | 12 |
| Amber | 8 | 63.34 | 13 | 73.94 | 19 | 71.02 | 15 | 72.20 | 12 | 75.50 | 71.20 | 13 |
| Ubehlana | 4 | 69.50 | 21 | 69.78 | 22 | 66.94 | 20 | 69.10 | 4 | 77.00 | 70.46 | 14 |
| Orange | 9 | 62.93 | 20 | 70.55 | 15 | 72.08 | 21 | 68.20 | 8 | 76.71 | 70.09 | 15 |

In Tables XXIV and XXV the percentage of each variety examined showing the indicated per cent of sucrose in the juice of the canes examined for seed selection for the season of 1892 are given. These results were determined by finding the number of the various sucrose per cents and purities for each variety, falling within the limits given, and then determining the per cent they were of the total number of selections for that individual variety. As no polarizations have been omitted in this table it is possible to form an accurate estimate of the actual value of each variety. In doing this, however, due regard must be given to the total number of selections made.

**Table XXIV.**—*Giving the relative per cent of each variety falling within the given classications for sucrose in juice.*

| Variety. | Below 11. | 11. | 12. | 13. | 14. | 15. | 16. | 17. | 18. | 19. | 20. | Above 20. | Total number selected. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
|  | *P. ct.* | *P. ct.* | *P. ct.* | *P. ct.* | *P. ct.* | *P. ct.* | *P. ct.* | *P. ct.* | *P. ct.* | *P. ct.* | *P. ct.* | *P. ct.* |  |
| Amber | 2.52 | 10.97 | 50.30 | 32.16 | 3.85 | 0.14 | 0 | 0 | 0.04 | 0 | 0 | 0 | 3,024 |
| Brown | 36.59 | 43.90 | 17.07 | 0 | 2.43 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 41 |
| Colman | 1.26 | 0.74 | 1.39 | 3.81 | 6.68 | 11.28 | 29.41 | 33.09 | 10.59 | 1.65 | 0.79 | 0 | 8,773 |
| Collier | 0.01 | 0.05 | 0.15 | 0.80 | 1.93 | 7.13 | 17.00 | 28.83 | 29.98 | 12.85 | 1.20 | 0.01 | 5,816 |
| Cross 5X | 0 | 0 | 0 | 0 | 2.38 | 23.81 | 52.38 | 16.67 | 4.76 | 0 | 0 | 0 | 42 |
| Cross 8X | 0.30 | 0.30 | 2.42 | 9.69 | 18.79 | 36.97 | 28.79 | 2.42 | 0.30 | 0 | 0 | 0 | 330 |
| Cross 14X | 0 | 0 | 0.39 | 1.97 | 2.87 | 14.68 | 19.37 | 29.25 | 26.88 | 5.13 | 0 | 0 | 253 |
| Cross 15X | 0 | 0 | 7.69 | 7.69 | 53.85 | 28.20 | 2.56 | 0 | 0 | 0 | 0 | 0 | 39 |
| Cross 42X | 0.36 | 0.36 | 0.72 | 2.16 | 7.22 | 21.30 | 37.54 | 23.83 | 6.49 | 0 | 0 | 0 | 277 |
| Cross 180X | 0 | 0 | 0 | 50.00 | 50.00 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 14 |
| Cross 292X | 2.94 | 0 | 0 | 5.88 | 5.88 | 11.76 | 47.06 | 23.53 | 2.94 | 0 | 0 | 0 | 34 |
| Folger | 0.87 | 2.42 | 11.73 | 32.35 | 38.50 | 13.52 | 0.55 | 0.02 | 0 | 0 | 0 | 0 | 11,467 |
| Golden Orange | 0 | 8.82 | 2.94 | 2.94 | 47.06 | 32.35 | 2.94 | 0 | 0 | 0 | 2.94 | 0 | 34 |
| Imphee | 0 | 0 | 0 | 0 | 0 | 45.45 | 54.54 | 0 | 0 | 0 | 0 | 0 | 11 |
| Kansas Orange | 0 | 0 | 0 | 0 | 10.52 | 57.89 | 31.58 | 0 | 0 | 0 | 0 | 0 | 19 |
| Link | 0.15 | 0.31 | 1.55 | 4.50 | 11.49 | 22.52 | 34.62 | 21.27 | 3.10 | 0.46 | 0 | 0 | 644 |
| McLean | 0.10 | 0.24 | 1.29 | 6.05 | 15.31 | 21.48 | 23.71 | 22.74 | 8.23 | 0.69 | 0 | 0 | 3,711 |
| Orange | 0 | 0 | 0 | 0 | 1.75 | 7.89 | 18.43 | 35.01 | 22.81 | 14.03 | 0 | 0 | 114 |
| Planter | 0.12 | 0.50 | 1.79 | 2.16 | 7.37 | 13.11 | 28.88 | 30.53 | 13.11 | 2.16 | 0.25 | 0 | 786 |
| Seedless | 0 | 0 | 0 | 2.65 | 7.31 | 20.73 | 39.93 | 26.83 | 2.43 | 0 | 0 | 0 | 82 |
| No. 161 | 0.26 | 2.10 | 7.36 | 46.84 | 34.21 | 5.26 | 2.89 | 1.05 | 0 | 0 | 0 | 0 | 380 |
| No. 208 | 0 | 0.37 | 0.37 | 1.86 | 6.34 | 12.69 | 32.46 | 29.48 | 14.18 | 2.23 | 0 | 0 | 268 |
| No. 289 | 0 | 0.18 | 0.56 | 2.43 | 12.37 | 31.21 | 38.69 | 13.27 | 0.37 | 0 | 0 | 0 | 535 |
| No. 592 | 0 | 0 | 0 | 2.17 | 9.78 | 15.22 | 33.69 | 31.52 | 7.60 | 0 | 0 | 0 | 92 |
| Mean | 0.81 | 1.74 | 7.42 | 14.92 | 17.72 | 12.75 | 15.77 | 17.19 | 8.83 | 2.57 | 0.21 | 0.03 | 1,470 |
| Maximum | 36.59 | 43.90 | 50.30 | 50.00 | 53.85 | 57.89 | 54.54 | 35.09 | 29.98 | 14.03 | 2.94 | ...... | ...... |

**TABLE XXV.**—*Giving the relative per cent of each variety falling within the given classification of purity.*

| Variety. | Below 70. | 70. | 71. | 72. | 73. | 74. | 75. |
|---|---|---|---|---|---|---|---|
| | *Per ct.* | *Per ct.* | *Per ct.* | *Per ct.* | *Per ct* | *Per ct.* | *Per ct.* |
| Amber | 49.06 | 19.02 | 16.25 | 9.98 | 3.45 | 0.93 | 0.49 |
| Brown | 97.57 | 0 | 2.43 | 0 | 0 | 0 | 0 |
| Colman | 15.21 | 2.67 | 3.87 | 4.73 | 5.92 | 7.94 | 10.90 |
| Collier | 10.69 | 2.99 | 4.62 | 5.48 | 8.70 | 12.49 | 15.29 |
| Cross 5X | 4.76 | 2.38 | 7.14 | 9.52 | 7.14 | 16.67 | 16.67 |
| Cross 8X | 17.92 | 4.24 | 9.39 | 14.24 | 19.09 | 17.27 | 9.39 |
| Cross 14X | 14.66 | 1.18 | 3.55 | 7.90 | 14.62 | 18.58 | 20.16 |
| Cross 15X | 20.53 | 5.12 | 12.82 | 33.33 | 12.82 | 12.82 | 2.56 |
| Cross 42X | 18.46 | 8.24 | 5.05 | 6.13 | 12.63 | 11.55 | 16.97 |
| Cross 180X | 71.43 | 7.14 | 21.43 | 0 | 0 | 0 | 0 |
| Cross 292X | 23.55 | 0 | 8.82 | 8.82 | 11.76 | 17.65 | 2.94 |
| Folger | 53.58 | 8.96 | 11.11 | 7.76 | 4.59 | 2.24 | 0.90 |
| Golden Orange | 55.88 | 17.65 | 17.65 | 2.94 | 2.94 | 2.94 | 0 |
| Imphee | 0.01 | 9.09 | 0 | 36.36 | 45.45 | 9.09 | 0 |
| Kansas Orange | 10.55 | 0 | 0 | 5.26 | 5.26 | 10.52 | 36.84 |
| Link | 11.06 | 6.36 | 7.76 | 10.56 | 17.08 | 15.84 | 13.97 |
| McLean | 6.57 | 3.28 | 4.92 | 7.61 | 11.03 | 15.10 | 15.96 |
| Orange | 10.59 | 4.38 | 2.63 | 3.50 | 3.50 | 11.40 | 13.15 |
| Planter | 30.47 | 6.61 | 7.88 | 10.68 | 9.92 | 10.94 | 8.90 |
| Seedless | 12.27 | 1.21 | 7.31 | 6.09 | 13.41 | 17.07 | 23.17 |
| No. 161 | 8.17 | 3.68 | 4.47 | 11.31 | 24.47 | 24.47 | 15.53 |
| No. 208 | 7.52 | 1.11 | 2.61 | 3.35 | 4.47 | 11.94 | 10.07 |
| No. 289 | 6.21 | 5.79 | 7.10 | 9.72 | 15.70 | 14.58 | 13.83 |
| No. 592 | 17.42 | 1.08 | 5.43 | 6.52 | 5.43 | 8.69 | 17.39 |
| Mean | 31.51 | 5.99 | 7.60 | 6.83 | 7.20 | 7.88 | 8.43 |
| Maximum | 97.57 | 19.02 | 21.43 | 36.36 | 45.45 | 24.47 | 36.84 |

| Variety. | 76. | 77. | 78. | 79. | 80. | Above 80. | Total number selections. |
|---|---|---|---|---|---|---|---|
| | *Per ct.* | *Per ct.* | *Per ct.* | *Per ct.* | *Per ct.* | *Per ct.* | |
| Amber | 0.24 | 0.19 | 0.09 | 0.09 | 0.09 | 0.13 | 2,024 |
| Brown | 0 | 0 | 0 | 0 | 0 | 0 | 41 |
| Colman | 13.47 | 14.10 | 11.81 | 5.47 | 2.21 | 1.70 | 8,773 |
| Collier | 14.27 | 12.00 | 7.11 | 3.19 | 1.29 | 1.93 | 5,316 |
| Cross 5X | 14.29 | 14.29 | 2.38 | 0 | 2.38 | 2.38 | 42 |
| Cross 8X | 6.66 | 0.90 | 0.30 | 0.60 | 0 | 0 | 330 |
| Cross 14X | 11.46 | 6.32 | 0.39 | 0.79 | 0.39 | 0 | 253 |
| Cross 15X | 0 | 0 | 0 | 0 | 0 | 0 | 39 |
| Cross 42X | 11.91 | 8.66 | 3.24 | 1.80 | 0.36 | 0 | 277 |
| Cross 180X | 0 | 0 | 0 | 0 | 0 | 0 | 14 |
| Cross 292X | 14.70 | 5.88 | 2.94 | 2.94 | 0 | 0 | 34 |
| Folger | 0.48 | 0.21 | 0.06 | 0.05 | 0.02 | 0.04 | 11,467 |
| Golden Orange | 0 | 0 | 0 | 0 | 0 | 0 | 34 |
| Imphee | 0 | 0 | 0 | 0 | 0 | 0 | 11 |
| Kansas Orange | 15.79 | 5.26 | 10.52 | 0 | 0 | 0 | 19 |
| Link | 9.16 | 4.34 | 1.86 | 0.93 | 0.46 | 0.62 | 644 |
| McLean | 14.66 | 10.79 | 6.27 | 1.99 | 0.86 | 0.96 | 3,711 |
| Orange | 16.67 | 14.03 | 7.89 | 5.26 | 3.50 | 3.50 | 114 |
| Planter | 7.25 | 4.45 | 1.78 | 0.50 | 0.50 | 0.12 | 786 |
| Seedless | 8.53 | 6.09 | 2.43 | 1.21 | 1.21 | 0 | 82 |
| No. 161 | 4.47 | 1.31 | 0.52 | 0.78 | 0.26 | 0.26 | 380 |
| No. 208 | 14.93 | 16.04 | 15.67 | 6.71 | 3.73 | 1.85 | 268 |
| No. 289 | 11.96 | 8.41 | 3.36 | 1.86 | 0.87 | 1.12 | 535 |
| No. 592 | 14.13 | 11.96 | 9.78 | 2.17 | 0 | 0 | 92 |
| Mean | 8.47 | 7.20 | 5.05 | 2.24 | 0.90 | 0.72 | 1,470 |
| Maximum | 16.67 | 16.04 | 15.67 | 6.71 | 3.73 | 3.50 | ........ |

Fifteen of the most promising varieties were grown under conditions as like as possible. An extensive physical and chemical examination was made of these varieties. The data obtained are recorded in the following table (No. XXVII).

TABLE XXVII.—*Chemical and physical examination of sorghum.*

| Variety. | Date. | Number of canes. | Mean height of canes. | Mean number of joints. | Mean length between joints. | | | Mean length of— | | | Diameter of cane at— | | | Mean diameter of— | | Extreme spread of roots. | Mean spread of roots. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | First third. | Second third. | Third third. | Seed head. | Leaves. | Roots. | Base. | Middle. | Top. | Leaves. | Seed head. | | |
| | | | *Inches.* | | *Inches.* | *Inches.* | *Inches.* | *Inches.* | *Inches.* | *Inches.* | *Inches.* | *Inches.* | *Inches.* | *Inches.* | *Inches.* | *Inches.* | *Inches.* |
| Amber | Aug. 30 | 4 | 106.9 | 8.75 | 6.21 | 10.18 | 15.70 | 13.25 | 27.25 | 15.60 | 0.71 | 0.65 | 0.37 | 3.03 | 3.65 | 19.62 | 7.50 |
| Do | Sept. 17 | ........ | ........ | ........ | ........ | ........ | ........ | ........ | ........ | ........ | ........ | ........ | ........ | ........ | ........ | ........ | ........ |
| Do | Oct. 4 | 4 | 95.6 | 7.75 | 7.65 | 9.40 | ........ | 12.38 | ........ | 14.00 | 0.64 | 0.51 | 0.28 | ........ | 2.37 | 11.80 | 4.43 |
| Colman | Sept. 10 | 3 | 91.3 | 11.70 | 6.50 | 7.30 | 6.30 | 7.70 | 25.40 | 15.30 | 0.91 | 0.77 | 0.41 | 3.17 | 3.30 | 14.80 | 5.30 |
| Do | Sept. 17 | 5 | 101.7 | 13.20 | 4.56 | 7.20 | 6.85 | 8.50 | ........ | 15.10 | 0.85 | 0.63 | 0.43 | ........ | 2.30 | 15.40 | 4.45 |
| Do | Oct. 4 | 2 | 89.5 | 12.00 | 6.15 | 6.60 | 6.05 | 9.00 | ........ | 12.50 | 1.00 | 0.62 | 0.34 | ........ | 2.37 | 13.50 | 6.00 |
| Collier | Sept. 2 | 5 | 107.5 | 10.80 | 6.06 | 6.60 | 6.70 | 11.60 | 21.80 | 15.80 | 0.67 | 0.56 | 0.25 | 2.54 | 1.85 | 18.50 | 6.45 |
| Do | Sept. 17 | 5 | 120.5 | 12.80 | 6.50 | 8.50 | 7.40 | 9.70 | ........ | 16.80 | 0.90 | 0.61 | 0.42 | ........ | 3.40 | 14.20 | 6.50 |
| Do | Oct. 4 | 3 | 122.8 | 12.30 | 7.63 | 7.20 | 8.40 | 9.16 | ........ | 15.00 | 0.68 | 0.61 | 0.23 | ........ | 3.30 | 16.00 | 5.17 |
| Folger | Aug. 31 | 3 | 106.2 | 11.00 | 6.86 | 8.85 | 9.60 | 9.75 | 22.93 | 15.60 | 0.79 | 0.64 | 0.31 | 3.02 | 2.70 | 17.90 | 6.30 |
| Do | Sept. 17 | 7 | 86.0 | 10.60 | 4.50 | 6.40 | 7.30 | 8.90 | ........ | 14.30 | 0.68 | 0.60 | 0.37 | ........ | 1.30 | 14.80 | 4.05 |
| Do | Oct. 4 | 5 | 91.0 | 10.00 | 7.30 | 6.90 | 8.30 | 9.30 | ........ | 14.80 | 0.87 | 0.50 | 0.45 | ........ | 1.70 | 15.00 | 4.70 |
| Link | Sept. 10 | 3 | 113.1 | 11.60 | 6.20 | 7.90 | 7.40 | 10.60 | 25.80 | 17.30 | 0.85 | 0.56 | 0.27 | 3.08 | 2.83 | 17.10 | 5.50 |
| Do | Sept. 17 | 4 | 112.7 | 13.30 | 5.80 | 7.10 | 6.90 | 10.42 | ........ | 18.80 | 0.81 | 0.62 | 0.27 | ........ | 2.80 | 13.70 | 5.50 |
| Do | Oct. 4 | 3 | 112.5 | 12.70 | 6.03 | 8.73 | 7.17 | 10.80 | ........ | 17.30 | 0.79 | 0.50 | 0.29 | ........ | 2.90 | 17.00 | 5.00 |
| McLean | Sept. 3 | 4 | 105.1 | 10.20 | 6.50 | 7.90 | 8.00 | 11.20 | 22.00 | 17.30 | 0.70 | 0.73 | 0.43 | 2.20 | 2.10 | 17.30 | 5.00 |
| Do | Sept. 17 | 4 | 113.4 | 11.50 | 5.98 | 8.42 | 7.85 | 11.78 | ........ | 20.40 | 0.83 | 0.61 | 0.42 | ........ | 3.50 | 17.50 | 4.60 |
| Do | Oct. 4 | 4 | 114.7 | 10.25 | 7.80 | 9.08 | 8.70 | 11.50 | ........ | 18.80 | 0.90 | 0.54 | 0.33 | ........ | 1.87 | 20.80 | 5.14 |
| Orange | Sept. 10 | 3 | 106.8 | 13.30 | 6.20 | 7.30 | 5.80 | 7.16 | 28.10 | 15.00 | 0.85 | 0.58 | 0.23 | 2.80 | 1.80 | 14.00 | 4.08 |
| Do | Sept. 17 | 2 | 109.8 | 16.50 | 4.45 | 6.75 | 6.65 | 6.50 | ........ | 15.80 | 1.03 | 0.81 | 0.50 | ........ | 2.25 | 16.50 | 5.00 |
| Do | Oct. 4 | 3 | 106.3 | 13.30 | 6.30 | 6.80 | 6.30 | 6.50 | ........ | 12.30 | 0.85 | 0.54 | 0.29 | ........ | 1.47 | 10.80 | 6.70 |
| Planter | Sept. 10 | 4 | 99.4 | 11.20 | 6.50 | 6.80 | 6.20 | 9.60 | 23.00 | 16.70 | 0.68 | 0.59 | 0.26 | 3.00 | 3.20 | 12.50 | 4.60 |
| Do | Sept. 17 | 3 | 107.3 | 14.30 | 4.10 | 6.60 | 7.40 | 8.42 | ........ | 15.80 | 0.85 | 0.73 | 0.50 | ........ | 3.70 | 17.76 | 5.00 |
| Do | Oct. 4 | 4 | 101.9 | 12.00 | 6.60 | 7.45 | 6.18 | 8.94 | ........ | 17.13 | 0.64 | 0.56 | 0.30 | ........ | 2.88 | 21.80 | 5.13 |
| Cross 8 X | Sept. 10 | 3 | 111.6 | 12.00 | 5.70 | 6.40 | 6.80 | 12.70 | 25.30 | 17.25 | 0.93 | 0.76 | 0.33 | 2.47 | 3.70 | 19.00 | 6.90 |
| Do | Sept. 17 | 4 | 110.1 | 13.50 | 4.65 | 6.25 | 6.56 | 12.30 | ........ | 15.70 | 0.90 | 0.64 | 0.49 | ........ | 2.64 | 16.30 | 4.64 |
| Do | Oct. 4 | 3 | 114.0 | 12.70 | 5.83 | 6.87 | 7.50 | 12.90 | ........ | 17.85 | 0.91 | 0.60 | 0.31 | ........ | 3.30 | 18.20 | 5.70 |
| Cross 14 X | Sept. 10 | 4 | 102.2 | 12.00 | 5.10 | 5.20 | 5.50 | 10.60 | 27.30 | 16.30 | 0.81 | 0.56 | 0.26 | 2.90 | 2.50 | 16.00 | 4.25 |
| Do | Sept. 17 | 5 | 107.3 | 13.40 | 4.80 | 6.80 | 5.70 | 10.70 | ........ | 14.30 | 0.99 | 0.70 | 0.42 | ........ | 2.85 | 15.80 | 5.00 |
| Do | Oct. 4 | 3 | 105.0 | 13.00 | 5.80 | 6.13 | 5.90 | 12.00 | ........ | 15.70 | 0.90 | 0.60 | 0.27 | ........ | 2.97 | 17.00 | 4.50 |
| No. 40 | Sept. 17 | 2 | 126.5 | 12.50 | 6.60 | 9.30 | 7.95 | 12.90 | ........ | 21.75 | 0.93 | 0.75 | 0.53 | ........ | 2.50 | 19.40 | 6.25 |
| Do | Oct. 4 | 3 | 117.0 | 11.30 | 6.20 | 8.30 | 7.60 | 13.70 | ........ | 17.00 | 0.71 | 0.54 | 0.29 | ........ | 2.70 | 13.70 | 4.10 |
| No. 112 | Sept. 2 | 5 | 84.6 | 11.40 | 5.40 | 6.50 | 5.60 | 8.10 | 22.20 | 16.20 | 0.76 | 0.50 | 0.36 | 2.30 | 2.05 | 15.60 | 5.40 |
| Do | Sept. 17 | 4 | 86.1 | 11.80 | 6.50 | 6.20 | 5.20 | 7.30 | ........ | 11.50 | 0.92 | 0.50 | 0.30 | ........ | 2.40 | 14.00 | 4.87 |
| Do | Oct. 4 | 5 | 85.3 | 11.40 | 5.80 | 7.60 | 6.14 | 7.65 | ........ | 15.60 | 0.75 | 0.60 | 0.40 | ........ | 2.30 | 13.60 | 4.60 |
| No. 161 | Sept. 2 | 3 | 113.6 | 11.30 | 6.04 | 7.16 | 7.07 | 10.00 | 27.90 | 15.00 | 0.83 | 0.56 | 0.33 | 2.89 | 3.25 | 15.70 | 6.40 |
| Do | Sept. 17 | 3 | 112.0 | 12.30 | 5.70 | 7.13 | 9.00 | 11.30 | ........ | 13.80 | 0.71 | 0.62 | 0.44 | ........ | 2.00 | 10.80 | 5.90 |
| Do | Oct. 4 | 2 | 113.5 | 12.50 | 4.50 | 6.30 | 6.60 | 10.25 | ........ | 18.50 | 0.87 | 0.70 | 0.41 | ........ | 1.75 | 12.00 | 6.00 |
| No. 208 | Sept. 17 | 2 | 122.5 | 13.50 | 5.65 | 6.65 | 7.45 | 12.12 | ........ | 18.00 | 0.90 | 0.62 | 0.56 | ........ | 2.75 | 12.50 | 5.75 |
| Do | Oct. 4 | 2 | 127.0 | 13.50 | 6.15 | 6.80 | 7.00 | 13.37 | ........ | 23.40 | 1.00 | 0.66 | 0.34 | ........ | 4.25 | 22.25 | 6.25 |
| No. 289 | Sept. 17 | 4 | 102.0 | 12.50 | 5.90 | 7.70 | 6.40 | 8.62 | ........ | 16.20 | 0.91 | 0.62 | 0.56 | ........ | 3.30 | 14.76 | 5.80 |
| Do | Oct. 4 | 4 | 97.6 | 12.30 | 6.25 | 7.08 | 6.10 | 9.00 | ........ | 18.00 | 0.73 | 0.61 | 0.29 | ........ | 2.88 | 16.00 | 5.80 |

### TABLE XXVII.—*Chemical and physical examination of sorghum*—Continued.

| Variety. | Date. | Number of canes. | Mean weight of— Stalk. | Mean weight of— Seed head. | Mean weight of— Leaves. | Mean weight of— Roots. | Mean volume of— Seed head. | Mean volume of— Leaves. | Mean volume of— Roots. | Solids in juice. | Sucrose in juice. | Glucose in juice. | Purity of juice. | Non-sugar in juice. | Ratio of glucose to sucrose. | Bodies precipitated by 95 per cent alcohol. | Fiber in cane. | Moisture in cane. | Acidity of juice (expressed in $\frac{N}{10}$ alkali). |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | *Ozs.* | *Ozs.* | *Ozs.* | *Ozs.* | *c. c.* | *c. c.* | *c. c.* | *Per ct.* | *Per ct.* | *Per ct.* | | *Per ct.* | | *Per ct.* | *Per ct.* | *Per ct.* | *c. c.* |
| Amber | Aug. 30 | 4 | 14.80 | 2.25 | 4.18 | 2.00 | 67.5 | 142.5 | 35.0 | 14.68 | 9.40 | 0.83 | 64.03 | 4.45 | 11.32 | 0.4130 | 8.11 | 78.73 | 89.0 |
| Do | Sept. 17 | ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... | 17.18 | 13.80 | 1.18 | 71.92 | 4.20 | 8.55 | 0.4002 | 10.25 | 72.12 | 89.0 |
| Do | Oct. 4 | 4 | 8.69 | 7.17 | 1.06 | 1.97 | 43.8 | 92.5 | 47.5 | 19.80 | 13.40 | 0.90 | 73.20 | 5.50 | 6.71 | 0.4440 | ...... | 69.80 | 100.0 |
| Colman | Sept. 10 | 3 | 17.50 | 4.10 | 5.92 | 5.25 | 108.0 | 215.0 | 125.0 | 18.85 | 14.60 | 0.56 | 77.45 | 3.69 | 3.83 | 0.6225 | 10.60 | 72.50 | 58.0 |
| Do | Sept. 17 | 5 | 11.30 | 1.87 | 3.17 | 2.75 | 55.0 | 145.0 | 62.0 | 19.88 | 15.00 | 0.86 | 75.45 | 4.03 | 5.73 | 0.6370 | 12.57 | 70.65 | 80.0 |
| Do | Oct. 4 | 2 | 17.37 | 2.12 | 2.75 | 4.25 | 80.0 | 112.5 | 132.5 | 21.80 | 16.70 | 0.82 | 76.60 | 4.28 | 4.91 | 0.6193 | 10.05 | 69.98 | 108.0 |
| Collier | Sept. 2 | 5 | 11.80 | 1.67 | 3.60 | 2.02 | 45.0 | 135.0 | 55.0 | 17.40 | 12.20 | 0.52 | 70.10 | 4.68 | 4.26 | 0.5930 | 10.36 | 74.21 | 76.0 |
| Do | Sept. 17 | 5 | 16.10 | 1.45 | 5.82 | 3.25 | 46.0 | 26.0 | 81.0 | 20.08 | 15.20 | 0.47 | 75.69 | 4.41 | 3.08 | 0.6971 | ...... | 71.10 | 92.0 |
| Do | Oct. 4 | 3 | 17.70 | 0.63 | 4.13 | 3.96 | 35.0 | 181.7 | 108.3 | 22.40 | 17.00 | 0.48 | 76.00 | 4.92 | 2.82 | 0.8640 | 11.32 | 69.12 | 130.0 |
| Folger | Aug. 31 | 3 | 16.25 | 1.45 | 4.62 | 3.08 | 41.6 | 168.0 | 83.3 | 16.44 | 9.75 | 1.15 | 59.31 | 5.64 | 11.79 | 0.5610 | 10.36 | 75.59 | 44.0 |
| Do | Sept. 17 | 7 | 7.59 | 0.42 | 2.30 | 1.96 | 14.8 | 97.0 | 47.0 | 19.78 | 14.10 | 1.75 | 71.28 | 3.93 | 12.41 | 0.6337 | 10.71 | 71.68 | 60.0 |
| Do | Oct. 4 | 5 | 11.75 | 0.82 | 1.80 | 2.30 | 23.0 | 79.0 | 58.0 | 20.50 | 14.80 | 0.51 | 72.20 | 5.19 | 3.44 | 0.5744 | 12.64 | 68.77 | 100.0 |
| Link | Sept. 10 | 3 | 14.90 | 2.25 | 4.91 | 3.75 | 83.0 | 205.0 | 66.6 | 16.54 | 12.10 | 0.47 | 73.15 | 3.97 | 3.88 | 0.4977 | 9.89 | 74.74 | 75.0 |
| Do | Sept. 17 | 4 | 12.70 | 1.92 | 4.77 | 2.77 | 66.6 | 126.7 | 61.7 | 18.08 | 13.10 | 1.15 | 72.45 | 3.83 | 8.77 | 0.6418 | 10.91 | 72.81 | 65.0 |
| Do | Oct. 4 | 3 | 14.60 | 1.56 | 2.17 | 3.33 | 61.7 | 167.0 | 86.7 | 21.40 | 16.00 | 0.78 | 74.80 | 4.62 | 4.87 | 0.7688 | 10.69 | 70.40 | 96.0 |
| McLean | Sept. 3 | 4 | 11.20 | 1.30 | 3.40 | 2.10 | 45.0 | 87.5 | 55.0 | 17.55 | 12.50 | 0.61 | 71.22 | 4.44 | 4.88 | 0.4386 | 9.25 | 75.18 | 68.7 |
| Do | Sept. 17 | 4 | 13.50 | 2.10 | 4.20 | 3.77 | 61.2 | 184.0 | 100.0 | 20.48 | 15.50 | 0.64 | 75.68 | 4.34 | 4.13 | 0.6802 | 10.98 | 71.85 | 89.0 |
| Do | Oct. 4 | 4 | 14.20 | 1.68 | 2.41 | 2.62 | 56.2 | 101.2 | 68.8 | 21.60 | 15.90 | 0.56 | 73.60 | 4.14 | 3.52 | 0.5347 | 11.98 | 68.69 | 120.0 |
| Orange | Sept. 10 | 3 | 14.60 | 0.58 | 4.75 | 4.08 | 25.0 | 195.0 | 95.0 | 20.09 | 15.60 | 0.42 | 77.65 | 4.07 | 2.70 | 0.7970 | 9.85 | 72.27 | 80.0 |
| Do | Sept. 17 | 2 | 22.12 | 1.00 | 4.94 | 3.75 | 40.0 | 235.0 | 92.5 | 18.78 | 13.70 | 1.58 | 72.94 | 3.50 | 11.53 | 0.4600 | 8.12 | 75.76 | 68.0 |
| Do | Oct. 4 | 3 | 24.20 | 0.66 | 1.83 | 2.40 | 31.7 | 86.6 | 65.0 | 23.20 | 13.60 | 0.74 | 58.50 | 8.86 | 5.44 | 0.9812 | 10.79 | 69.11 | 136.0 |
| Planter | Sept. 10 | 4 | 11.80 | 1.56 | 4.62 | 3.68 | 47.5 | 188.7 | 77.5 | 16.99 | 11.80 | 0.73 | 69.44 | 4.46 | 6.19 | 0.5755 | 10.21 | 75.14 | 65.0 |
| Do | Sept. 17 | 3 | 16.70 | 1.87 | 5.23 | 3.23 | 58.3 | 236.0 | 78.3 | 19.18 | 13.80 | 1.72 | 71.94 | 3.66 | 12.46 | 0.6065 | 11.66 | 70.68 | 60.0 |
| Do | Oct. 4 | 4 | 13.50 | 1.50 | 3.25 | 3.44 | 48.7 | 142.5 | 87.5 | 20.90 | 14.50 | 1.47 | 69.40 | 4.93 | 10.13 | 0.6238 | 11.22 | 70.17 | 96.0 |
| Cross 8 X | Sept. 10 | 3 | 15.80 | 3.30 | ...... | 4.20 | 91.6 | 221.0 | 95.0 | 16.79 | 12.30 | 0.40 | 73.26 | 4.09 | 3.25 | 0.5671 | 10.48 | 75.31 | 50.0 |
| Do | Sept. 17 | 4 | 15.90 | 2.50 | 4.17 | 3.30 | 75.0 | 144.0 | 78.8 | 18.68 | 13.70 | 0.90 | 73.34 | 4.08 | 6.57 | 0.6100 | 10.66 | 73.34 | 76.0 |
| Do | Oct. 4 | 3 | 21.80 | 2.58 | 4.00 | 4.50 | 76.6 | 175.0 | 118.0 | 22.60 | 17.00 | 0.91 | 75.20 | 4.69 | 5.35 | 0.6190 | 12.51 | 68.29 | 128.0 |
| Cross 14 X | Sept. 10 | 4 | 11.60 | 1.81 | 4.56 | 3.56 | 88.0 | 57.5 | 48.7 | 18.98 | 14.10 | 0.87 | 74.44 | 4.51 | 2.62 | 0.8227 | 11.79 | 72.05 | 84.0 |
| Do | Sept. 17 | 5 | 16.00 | 2.45 | 5.27 | 3.77 | 71.0 | 215.0 | 79.0 | 18.78 | 13.70 | 0.69 | 72.94 | 4.39 | 5.08 | 0.5610 | 10.85 | 72.93 | 80.0 |
| Do | Oct. 4 | 3 | 16.70 | 1.67 | 2.58 | 3.41 | 70.0 | 103.0 | 125.0 | 23.40 | 17.20 | 1.00 | 73.40 | 5.20 | 5.81 | 0.8184 | 11.09 | 68.55 | 130.0 |
| No. 40 | Sept 17 | 2 | 21.06 | 1.75 | 5.93 | 7.00 | 75.0 | 245.0 | 167.5 | 20.78 | 15.30 | 0.60 | 73.14 | 4.88 | 3.92 | 0.7190 | 12.72 | 66.85 | 120.0 |
| Do | Oct. 4 | 3 | 13.70 | 1.91 | 2.00 | 3.75 | 75.0 | 88.3 | 118.3 | 21.50 | 16.50 | 1.45 | 76.90 | 3.55 | 8.78 | 0.7690 | ...... | 67.07 | 124.0 |
| No. 112 | Sept. 2 | 5 | 9.40 | 1.40 | 4.07 | 2.07 | 50.0 | 186.0 | 53.0 | 16.15 | 9.90 | 1.08 | 61.30 | 5.17 | 10.91 | 0.5160 | 9.71 | 76.15 | 50.2 |
| Do | Sept. 17 | 4 | 10.00 | 2.06 | 2.38 | 2.18 | 73.7 | 106.8 | 56.2 | 18.18 | 12.20 | 2.21 | 67.11 | 3.77 | 18.11 | 0.4747 | 10.35 | 72.28 | 58.5 |
| Do | Oct. 4 | 5 | 10.70 | 1.42 | 3.92 | 2.16 | 49.0 | 170.0 | 58.0 | 20.80 | 14.90 | 0.73 | 71.70 | 5.17 | 4.89 | 0.5645 | 10.88 | 70.74 | 108.0 |
| No. 161 | Sept. 2 | 3 | 14.20 | 0.83 | 6.40 | 3.10 | 91.6 | 358.0 | 75.0 | 17.37 | 12.80 | 0.46 | 73.80 | 4.09 | 3.50 | 0.6672 | 11.11 | 74.16 | 54.0 |

| | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Do ............ | Sept. 17 | 3 | 15.00 | 1.21 | 3.54 | 3.00 | 41.7 | 188.0 | 71.7 | 19.38 | 14.80 | 0.63 | 76.36 | 3.95 | 4.25 | 0.6210 | 10.82 | 71.25 | 80.0 |
| Do ............ | Oct. 4 | 2 | 16.70 | 1.25 | 1.75 | 3.75 | 50.0 | 97.5 | 80.0 | 18.70 | 13.70 | 0.44 | 73.80 | 4.56 | 3.21 | 0.4815 | 10.67 | 73.38 | 80.0 |
| No. 208............ | Sept. 17 | 2 | 17.12 | 2.50 | 1.28 | 4.00 | 87.5 | 202.0 | 92.5 | 18.08 | 13.60 | 0.87 | 75.22 | 3.61 | 6.40 | 0.5885 | 11.61 | 70.61 | 73.0 |
| Do ............ | Oct. 4 | 2 | 21.25 | 3.00 | 3.43 | 6.32 | 122.5 | 127.0 | 172.5 | 18.10 | 13.30 | 0.90 | 76.20 | 3.40 | 6.52 | 0.3780 | 12.26 | 73.36 | 72.0 |
| No. 289............ | Sept. 17 | 4 | 14.70 | 3.75 | 4.32 | 3.88 | 90.0 | 184.0 | 57.5 | 17.88 | 12.10 | 1.47 | 67.67 | 4.81 | 13.15 | 0.6585 | 9.71 | 74.53 | 69.0 |
| Do ............ | Oct. 4 | 4 | 15.50 | 2.31 | 2.30 | 3.00 | 66.2 | 93.7 | 77.7 | 19.30 | 14.00 | 1.39 | 72.60 | 3.91 | 9.92 | 0.5040 | 7.51 | 73.83 | 80.0 |

The advisability and necessity of finding some manner in which sorghum might be preserved, so as to extend the manufacturing season beyond its present limits, led to the experiments whose data are recorded in the tables which follow. Tables XXVIII and XXX give the results of keeping cane under such conditions as would be practicable. Table XXIX contains a series of experiments under conditions which gave the best results last year. In this series nine varieties of sorghum were used to determine at the same time their relative keeping qualities. It will be readily seen that the work in this direction has met with but little success.

TABLE XXVIII.—*Experiments upon the preservation of sorghum.*

| Manner of keeping. | Date. | Solids in juice. | Sucrose in juice. | Glucose in juice. | Purity of juice. | Ratio of glucose to sucrose. | Non-sugar in juice. |
|---|---|---|---|---|---|---|---|
| | | *Per ct.* | *Per ct,* | *Per ct.* | | | *Per ct.* |
| Put up in a shock upon soft, plowed ground | Sept. 23 | 20.80 | 13.40 | 3.10 | 64.40 | 23.13 | 4.30 |
| | Sept. 30 | 25.70 | 14.90 | 4.18 | 66.20 | 28.12 | 6.62 |
| | Oct. 7 | 26.70 | 14.90 | 4.57 | 56.60 | 30.67 | 7.23 |
| | Oct. 29 | 26.51 | 12.01 | 11.23 | 45.30 | 93.50 | 3.27 |
| Large pile on plowed ground, cane covered with leaves and trash | Sept. 23 | 20.80 | 14.50 | 1.92 | 64.90 | 13.24 | 4.38 |
| | Sept. 30 | 24.10 | 14.30 | 3.14 | 59.30 | 17.44 | 6.66 |
| | Oct. 7 | 25.60 | 16.90 | 3.10 | 66.00 | 18.34 | 5.60 |
| | Oct. 29 | 22.31 | 10.86 | 11.43 | 48.08 | 105.25 | 0.02 |
| Piles laid in windrow, butts covered with soil | Sept. 23 | 22.00 | 15.00 | 2.00 | 68.20 | 13.33 | 5.00 |
| | Sept. 30 | 24.60 | 14.40 | 2.86 | 58.50 | 19.86 | 7.34 |
| | Oct. 7 | 26.00 | 15.70 | 3.92 | 60.00 | 24.96 | 6.38 |
| | Oct. 29 | 26.06 | 12.98 | 13.84 | 49.81 | 106.62 | ....... |
| Piles laid cross windrow, butts dipped in cream of lime | Sept. 23 | 21.50 | 13.50 | 2.06 | 62.80 | 15.25 | 5.94 |
| | Sept. 30 | 25.40 | 15.20 | 3.05 | 59.80 | 20.06 | 7.15 |
| | Oct. 7 | 26.40 | 15.50 | 3.76 | 58.70 | 24.25 | 7.14 |
| | Oct. 29 | 26.21 | 7.07 | 18.08 | 27.00 | 255.72 | 1.06 |
| Piles laid in windrow as cut, without covering | Sept. 23 | 19.40 | 13.80 | 1.79 | 71.11 | 12.97 | 3.81 |
| | Sept. 30 | 24.40 | 14.50 | 2.83 | 59.60 | 19.51 | 7.07 |
| | Oct. 7 | 27.70 | 18.10 | 2.83 | 65.30 | 15.63 | 6.77 |
| | Oct. 29 | 26.23 | 14.52 | 7.99 | 55.29 | 55.02 | 3.72 |
| Piles laid cross windrow, without covering | Sept. 23 | 21.30 | 13.80 | 3.76 | 64.80 | 27.24 | 3.74 |
| | Sept. 30 | 25.00 | 14.20 | 4.37 | 56.80 | 30.77 | 6.43 |
| | Oct. 7 | 27.40 | 12.40 | 4.27 | 44.90 | 34.43 | 10.73 |
| | Oct. 29 | 26.01 | 14.96 | 10.30 | 57.51 | 62.16 | 0.75 |
| Piles in layers, one layer being at right angles to the other, covered with leaves and trash | Sept. 23 | 25.50 | 14.50 | 3.06 | 67.50 | 21.10 | 7.94 |
| | Sept. 30 | 23.80 | 12.20 | 5.35 | 51.30 | 43.85 | 6.25 |
| | Oct. 7 | 25.70 | 13.50 | 4.18 | 52.50 | 30.96 | 8.02 |
| | Oct. 29 | 24.01 | 12.49 | 11.71 | 52.02 | 93.75 | ....... |
| Pile out of direct rays of the sun, covered with leaves and kept moist | Sept. 23 | 20.40 | 14.30 | 1.73 | 70.00 | 12.09 | 3.37 |
| | Sept. 30 | 21.20 | 11.80 | 2.31 | 55.70 | 19.57 | 7.09 |
| | Oct. 7 | 21.80 | 11.70 | 3.62 | 53.60 | 30.94 | 6.48 |
| | Oct. 29 | 19.51 | 9.46 | 9.74 | 48.48 | 102.95 | 0.31 |
| Pile in haymow, without covering | Sept. 23 | 20.00 | 13.20 | 3.00 | 66.00 | 22.72 | 3.80 |
| | Sept. 30 | 24.60 | 13.70 | 3.62 | 55.70 | 26.42 | 7.28 |
| | Oct. 7 | 27.00 | 16.42 | 3.76 | 60.70 | 22.91 | 6.82 |

## TABLE XXIX.—*Experiments upon the preservation of sorghum.*

[Piled out of the direct rays of the sun, covered with leaves and kept moist.]

| Variety. | Date. | Solids in juice. | Sucrose in juice. | Glucose in juice. | Purity of juice. | Ratio of glucose to sucrose. | Non-sugar in juice. |
|---|---|---|---|---|---|---|---|
| | | *Per cent.* | *Per cent.* | *Per cent* | | | *Per cent.* |
| Cross 14 and 15X | Oct. 6 | 24.10 | 18.70 | 0.40 | 77.60 | 2.13 | 5.00 |
| Do | Oct. 10 | 25.10 | 18.70 | 0.90 | 74.50 | 4.81 | 5.50 |
| Do | Oct. 29 | 21.91 | 16.15 | 3.27 | 73.54 | 20.25 | 2.49 |
| Collier | Oct. 6 | 25.90 | 20.10 | 0.31 | 76.80 | 1.54 | 5.49 |
| Do | Oct. 10 | 26.60 | 20.20 | 1.07 | 75.90 | 5.29 | 5.33 |
| Do | Oct. 29 | 26.06 | 17.21 | 6.92 | 66.04 | 40.20 | 1.93 |
| Colman | Oct. 6 | 23.60 | 18.70 | 0.62 | 79.20 | 3.31 | 4.28 |
| Do | Oct. 10 | 26.70 | 18.60 | 0.77 | 69.60 | 4.13 | 7.33 |
| Do | Oct. 29 | 23.91 | 17.81 | 4.00 | 74.36 | 22.46 | 2.73 |
| Planter | Oct. 6 | 24.30 | 18.50 | 0.96 | 76.80 | 5.18 | 4.84 |
| Do | Oct. 10 | 25.00 | 19.00 | 1.21 | 76.00 | 6.36 | 5.21 |
| Do | Oct. 29 | 22.21 | 16.06 | 4.06 | 72.35 | 25.29 | 2.09 |
| McLean | Oct. 6 | 24.50 | 19.20 | 0.51 | 78.40 | 2.65 | 4.79 |
| Do | Oct. 10 | 25.70 | 16.80 | 1.14 | 72.86 | 6.78 | 7.76 |
| Do | Oct. 29 | 24.56 | 15.45 | 7.10 | 62.90 | 45.95 | 2.01 |
| Folger | Oct. 6 | 23.10 | 17.70 | 1.03 | 76.70 | 5.81 | 4.37 |
| Do | Oct. 10 | 23.90 | 17.70 | 1.48 | 74.00 | 8.36 | 4.72 |
| Do | Oct. 29 | 20.06 | 15.28 | 4.23 | 76.17 | 27.67 | 0.55 |
| Orange | Oct. 6 | 23.60 | 18.50 | 0.96 | 78.40 | 5.18 | 4.14 |
| Do | Oct. 10 | 24.30 | 19.40 | 1.48 | 79.80 | 7.62 | 3.42 |
| Do | Oct. 29 | 22.21 | 16.72 | 4.49 | 75.28 | 26.85 | 1.00 |
| Link | Oct. 6 | 23.90 | 18.80 | 0.45 | 78.60 | 2.39 | 4.65 |
| Do | Oct. 10 | 24.90 | 17.70 | 1.60 | 71.00 | 9.04 | 5.60 |
| Do | Oct. 29 | 24.16 | 16.35 | 6.36 | 67.67 | 36.91 | 1.45 |
| No. 289 | Oct. 6 | 22.90 | 17.80 | 0.87 | 77.80 | 4.88 | 4.23 |
| Do | Oct. 10 | 24.30 | 15.50 | 2.11 | 63.90 | 13.61 | 6.69 |
| Do | Oct. 29 | 22.21 | 18.01 | 3.93 | 81.09 | 21.82 | 0.27 |

## TABLE XXX.—*Experiments upon the preservation of sorghum.*

| Manner of keeping. | Date. | Solids in juice. | Sucrose in juice. | Glucose in juice. | Purity of juice. | Ratio of glucose to sucrose | Non-sugars in juice. |
|---|---|---|---|---|---|---|---|
| | | *Per ct.* | *Per ct.* | *Per ct.* | | | *Per ct.* |
| Pile out of direct rays of the sun, covered with leaves and kept moist | Aug. 30 | 18.55 | 11.40 | 1.26 | 66.20 | 11.05 | 5.89 |
| | Sept. 2 | 18.52 | 10.80 | 1.30 | 58.30 | 12.03 | 6.42 |
| | Sept. 7 | 16.90 | 8.80 | 2.86 | 52.10 | 32.50 | 5.24 |
| | Sept. 14 | 19.90 | 11.60 | 3.31 | 58.30 | 28.53 | 3.99 |
| Large pile in the field covered with leaves | Aug. 30 | 20.18 | 14.80 | 0.43 | 71.07 | 2.91 | 4.95 |
| | Sept. 2 | 21.93 | 14.90 | 1.36 | 67.90 | 9.12 | 5.67 |
| | Sept. 7 | 24.40 | 14.50 | 3.37 | 59.40 | 23.24 | 6.53 |
| | Sept. 14 | 26.20 | 13.80 | 4.18 | 52.60 | 30.28 | 8.22 |
| Large pile, butts dipped in cream of lime, covered with trash | Sept. 2 | 21.63 | 13.00 | 1.62 | 60.10 | 12.46 | 7.01 |
| | Sept. 7 | 23.00 | 12.00 | 3.92 | 52.20 | 32.66 | 7.08 |
| | Sept. 14 | 24.50 | 13.30 | 5.05 | 54.30 | 37.96 | 6.15 |
| Piles laid in windrow, butts dipped in cream of lime | Sept. 2 | 24.90 | 15.30 | 1.88 | 61.40 | 12.28 | 7.72 |
| | Sept. 7 | 24.30 | 14.10 | 3.69 | 57.60 | 26.17 | 6.51 |
| Piles laid in windrow as cut | Aug. 30 | 19.55 | 13.90 | 0.81 | 71.60 | 5.82 | 4.84 |
| | Sept. 2 | 21.63 | 12.45 | 1.60 | 57.10 | 12.85 | 7.58 |
| | Sept. 7 | 24.10 | 14.70 | 2.63 | 61.00 | 17.88 | 6.77 |

Table XXXI shows the effect of irrigation upon fifteen varieties of sorghum as compared with the same varieties grown without irrigation. In all but two cases the irrigated cane was inferior to that without irrigation:

TABLE XXXI.—*The effect of irrigation on sorghum cane.*

| Variety. | Solids in juice. | Sucrose in juice. | Glucose in juice. | Purity of juice. | Ratio of glucose to sucrose. | Non-sugar in juice. |
|---|---|---|---|---|---|---|
| | *Per cent.* | *Per cent.* | *Per cent.* | | | *Per cent.* |
| Amber, irrigated | 19.80 | 13.40 | 0.90 | 73.20 | 6.71 | 5.50 |
| Amber, nonirrigated | 19.20 | 14.50 | 0.60 | 75.50 | 4.13 | 4.10 |
| Folger, irrigated | 20.50 | 14.80 | 0.51 | 72.20 | 3.36 | 5.19 |
| Folger, nonirrigated | 21.50 | 16.60 | 1.46 | 77.20 | 8.79 | 3.44 |
| Collier, irrigated | 22.40 | 17.00 | 0.48 | 76.00 | 2.82 | 4.92 |
| Collier, nonirrigated | 24.40 | 18.10 | 0.44 | 74.20 | 2.43 | 5.86 |
| Planter, irrigated | 19.18 | 13.80 | 1.72 | 71.90 | 12.46 | 3.66 |
| Planter, nonirrigated | 22.70 | 18.10 | 0.62 | 74.20 | 3.42 | 3.98 |
| McLean, irrigated | 20.48 | 15.50 | 0.64 | 75.68 | 4.13 | 4.34 |
| McLean, nonirrigated | 23.30 | 18.70 | 0.82 | 80.20 | 1.67 | 4.28 |
| African, nonirrigated | 21.50 | 15.70 | 1.08 | 73.00 | 6.88 | 4.72 |
| Cross 8X, irrigated | 22.60 | 17.00 | 0.91 | 75.20 | 5.35 | 4.69 |
| Cross 8X, nonirrigated | 21.60 | 15.90 | 1.11 | 73.60 | 6.98 | 4.59 |
| No. 161, irrigated | 19.38 | 14.80 | 0.63 | 76.36 | 4.25 | 3.95 |
| No. 161, nonirrigated | 24.70 | 19.80 | 0.53 | 80.10 | 2.67 | 4.37 |
| No. 289, irrigated | 19.30 | 14.00 | 1.39 | 72.60 | 9.92 | 3.91 |
| No. 289, nonirrigated | 21.30 | 16.20 | 0.95 | 76.10 | 5.86 | 4.15 |
| No. 112, irrigated | 20.80 | 14.90 | 0.73 | 71.70 | 4.90 | 5.17 |
| No. 112, nonirrigated | 20.70 | 16.00 | 0.63 | 77.30 | 3.93 | 4.07 |
| No. 208, irrigated | 18.10 | 13.80 | 0.90 | 76.20 | 6.52 | 3.40 |
| No. 208, nonirrigated | 23.30 | 19.00 | 0.68 | 81.50 | 3.57 | 3.62 |
| Orange, irrigated | 20.09 | 15.60 | 0.42 | 77.65 | 2.69 | 4.07 |
| Orange, nonirrigated | 22.20 | 18.20 | 0.91 | 81.90 | 5.00 | 3.09 |
| Cross 14X, irrigated | 23.40 | 17.20 | 1.00 | 73.40 | 5.81 | 5.20 |
| Cross 14X, nonirrigated | 21.60 | 17.10 | 0.71 | 79.20 | 4.15 | 3.79 |
| Cross 15X, nonirrigated | 22.10 | 17.50 | 0.55 | 78.90 | 3.14 | 4.05 |
| Link, irrigated | 21.40 | 16.00 | 0.78 | 74.80 | 4.87 | 4.62 |
| Link, nonirrigated | 22.70 | 18.40 | 0.48 | 81.10 | 2.60 | 3.82 |
| Colman, irrigated | 21.80 | 16.70 | 0.82 | 76.60 | 4.91 | 4.28 |
| Colman, nonirrigated | 21.80 | 15.70 | 0.83 | 72.00 | 5.41 | 5.27 |

In Table XXXII are given the mean analyses of the several varieties, from the time they were first grown by the Department of Agriculture.

TABLE XXXII.—*Mean analyses of different varieties.*

AFRICAN.

[Average analysis of average samples.]

| Mean for— | Length of analytical season in days. | Number of analyses. | Sucrose in juice. | Glucose in juice. | Purity of juice. |
|---|---|---|---|---|---|
| | | | *Per cent.* | *Per cent.* | |
| 1889 | 44 | 11 | 14.24 | 0.81 | 76.32 |
| 1890 | 46 | 17 | 13.36 | 1.32 | 70.72 |
| 1891 | 32 | 4 | 14.80 | 1.25 | 73.70 |
| 1892 | 30 | 4 | 16.72 | 0.67 | 75.60 |

AMBER.

| | | | | | |
|---|---|---|---|---|---|
| 1888 | 19 | 10 | 9.50 | 2.35 | 63.84 |
| 1889 | 28 | 25 | 11.69 | 1.25 | 73.94 |
| 1890 | 26 | 12 | 12.84 | 1.50 | 71.02 |
| 1891 | 29 | 20 | 12.90 | 1.58 | 72.20 |
| 1892 | 30 | 1 | 14.50 | 0.60 | 75.50 |

**Table XXXII.**—*Mean analyses of different varieties*—Continued.

### COLLIER.

| Mean for— | Length of analytical season in days. | Number of analyses. | Sucrose in juice. | Glucose in juice. | Purity of juice. |
|---|---|---|---|---|---|
| | | | *Per cent.* | *Per cent.* | |
| 1888 | 27 | 4 | 12.31 | 0.73 | 71.69 |
| 1889 | 26 | 17 | 14.91 | 0.75 | 76.95 |
| 1890 | 34 | 18 | 15.95 | 0.59 | 74.77 |
| 1891 | 24 | 43 | 14.80 | 0.90 | 73.80 |
| 1892 | 30 | 35 | 18.50 | 0.49 | 78.19 |

### COLMAN.

| | | | | | |
|---|---|---|---|---|---|
| 1889 | 40 | 22 | 14.58 | 1.15 | 75.55 |
| 1890 | 36 | 45 | 14.88 | 0.84 | 76.38 |
| 1891 | 35 | 20 | 15.60 | 0.73 | 76.30 |
| 1892 | 30 | 60 | 16.93 | 0.50 | 77.95 |

### CROSS 15X.

| | | | | | |
|---|---|---|---|---|---|
| 1890 | 36 | 4 | 15.27 | 0.64 | 75.79 |
| 1891 | 18 | 2 | 15.95 | 0.40 | 75.30 |
| 1892 | 30 | 8 | 16.30 | 0.54 | 76.54 |

### CROSS 8X.

| | | | | | |
|---|---|---|---|---|---|
| 1890 | 26 | 9 | 14.88 | 0.86 | 74.98 |
| 1891 | 19 | 2 | 15.95 | 0.35 | 76.00 |
| 1892 | 30 | 13 | 16.45 | 0.49 | 75.33 |

### CROSS 5X.

| | | | | | |
|---|---|---|---|---|---|
| 1890 | 38 | 7 | 14.28 | 0.62 | 72.73 |
| 1891 | 23 | 2 | 15.80 | 0.50 | 77.05 |
| 1892 | 30 | 4 | 15.97 | 0.93 | 77.33 |

### ORANGE.

| | | | | | |
|---|---|---|---|---|---|
| 1888 | 17 | 12 | 10.40 | 2.80 | 62.93 |
| 1889 | 25 | 24 | 12.12 | 2.52 | 70.55 |
| 1890 | 32 | 5 | 13.50 | 2.15 | 72.08 |
| 1891 | 15 | 9 | 13.60 | 2.24 | 68.20 |
| 1892 | 30 | 8 | 17.49 | 0.92 | 76.71 |

### FOLGER.

| | | | | | |
|---|---|---|---|---|---|
| 1889 | 26 | 7 | 14.08 | 2.03 | 76.54 |
| 1890 | 50 | 32 | 14.12 | 1.75 | 74.91 |
| 1891 | 32 | 30 | 14.60 | 1.35 | 73.30 |
| 1892 | 30 | 12 | 15.57 | 0.91 | 74.75 |

### IMPHEE.

| | | | | | |
|---|---|---|---|---|---|
| 1889 | 27 | 6 | 13.81 | 0.61 | 76.38 |
| 1890 | 27 | 4 | 14.03 | 0.73 | 74.90 |
| 1891 | 33 | 12 | 14.10 | 1.10 | 69.00 |
| 1892 | 30 | 1 | 16.90 | 0.32 | 76.90 |

TABLE XXXII.—*Mean analyses of different varieties*—Continued.

### LINK.

| Mean for— | Length of analytical season in days. | Number of analyses. | Sucrose in juice. | Glucose in juice. | Purity of juice. |
|---|---|---|---|---|---|
| | | | *Per cent.* | *Per cent.* | |
| 1888 | 33 | 25 | 13.02 | 1.06 | 72.09 |
| 1889 | 28 | 62 | 15.16 | 0.65 | 79.00 |
| 1890 | 33 | 166 | 13.37 | 1.15 | 71.77 |
| 1891 | 22 | 87 | 14.85 | 0.83 | 73.35 |
| 1892 | 30 | 27 | 15.99 | 0.58 | 71.90 |

### McLEAN.

| | | | | | |
|---|---|---|---|---|---|
| 1890 | 36 | 12 | 15.22 | 0.52 | 76.00 |
| 1891 | 28 | 12 | 16.40 | 0.55 | 77.40 |
| 1892 | 30 | 31 | 17.24 | 0.47 | 76.80 |

### PLANTER.

| | | | | | |
|---|---|---|---|---|---|
| 1888 | 36 | 4 | 12.15 | 1.78 | 65.39 |
| 1889 | 25 | 55 | 14.45 | 1.47 | 76.06 |
| 1890 | 33 | 6 | 14.57 | 1.88 | 71.49 |
| 1891 | 21 | 8 | 15.80 | 1.00 | 75.08 |
| 1892 | 30 | 15 | 17.02 | 0.81 | 76.36 |

### No. 112.

| | | | | | |
|---|---|---|---|---|---|
| 1889 | 25 | 20 | 14.23 | 1.08 | 76.42 |
| 1890 | 38 | 7 | 13.55 | 1.13 | 74.75 |
| 1891 | 14 | 9 | 15.00 | 0.74 | 73.70 |
| 1892 | 30 | 7 | 16.11 | 0.69 | 76.37 |

### No. 161.

| | | | | | |
|---|---|---|---|---|---|
| 1889 | 43 | 18 | 13.24 | 0.45 | 77.33 |
| 1890 | 52 | 38 | 14.03 | 0.67 | 75.92 |
| 1891 | 29 | 18 | 14.60 | 0.81 | 74.80 |
| 1892 | 30 | 10 | 16.84 | 0.44 | 77.79 |

### No. 208.

| | | | | | |
|---|---|---|---|---|---|
| 1889 | 27 | 7 | 14.78 | 0.95 | 77.66 |
| 1890 | 20 | 11 | 15.46 | 0.89 | 77.70 |
| 1891 | 15 | 11 | 14.60 | 1.05 | 72.22 |
| 1892 | 30 | 16 | 16.29 | 0.65 | 77.16 |

### No. 289.

| | | | | | |
|---|---|---|---|---|---|
| 1890 | 21 | 9 | 15.69 | 0.84 | 76.47 |
| 1891 | 20 | 74 | 14.01 | 1.18 | 72.35 |
| 1892 | 30 | 20 | 15.56 | 0.95 | 74.89 |

## DATA RELATING TO TAKING SAMPLES IN THE FIELD.

As an illustration of the method which may be applied in sampling a field, the following data, obtained on a plat of 2,400 square feet, are of interest. One hill was taken each 10 paces and the canes were ground together:

*Direction of sampling and analytical data.*

| Directions. | No. of canes collected. | Solids in juice. | Sucrose in juice. | Glucose in juice. | Purity of juice. |
|---|---|---|---|---|---|
| *No. I.* | | | | | |
| | | *Per ct.* | *Per cent.* | *Per cent.* | |
| From northeast to southwest corner | 22.0 | 21.10 | 15.40 | 1.94 | 73.00 |
| Reverse from above | 21.0 | 22.00 | 16.00 | 1.57 | 72.70 |
| **Mean** | 21.5 | 21.55 | 15.70 | 1.75 | 72.85 |
| *No. II.* | | | | | |
| From northwest to southeast corner | 16.0 | 22.20 | 16.40 | 1.55 | 73.90 |
| Reverse from above | 20.0 | 22.40 | 16.40 | 1.65 | 73.90 |
| **Mean** | 18.0 | 22.30 | 16.40 | 1.62 | 73.90 |
| *No. III.* | | | | | |
| From middle of east side to middle of west | 19.0 | 22.10 | 15.90 | 1.55 | 71.90 |
| Reverse from above | 20.0 | 22.30 | 16.20 | 1.72 | 72.60 |
| **Mean** | 19.5 | 22.20 | 16.05 | 1.63 | 72.25 |
| *No. IV.* | | | | | |
| From middle of north side to middle of south | 16.0 | 22.20 | 15.80 | 1.95 | 71.20 |
| Reverse from above | 19.0 | 21.80 | 16.20 | 1.85 | 74.30 |
| **Mean** | 17.5 | 22.00 | 16.00 | 1.88 | 72.75 |
| *No. V.* | | | | | |
| Divided field into thirds, lines running east to west, northern line | 22.0 | 22.00 | 15.80 | 1.72 | 71.80 |
| Reverse from above | 19.0 | 22.30 | 15.90 | 1.86 | 71.30 |
| **Mean** | 20.5 | 22.15 | 15.85 | 1.79 | 71.55 |
| *No. VI.* | | | | | |
| As No. V, but on southern line | 29.0 | 21.20 | 15.00 | 1.76 | 74.20 |
| Reverse from above | 21.0 | 21.80 | 15.90 | 1.39 | 76.50 |
| **Mean** | 25.0 | 21.60 | 15.45 | 1.57 | 75.35 |
| *No. VII.* | | | | | |
| Divided as No. V, lines running north to south, eastern line | 21.0 | 22.40 | 16.30 | 1.65 | 72.80 |
| Reverse from above | 23.0 | 22.20 | 15.80 | 1.53 | 71.20 |
| **Mean** | 22.0 | 22.30 | 16.05 | 1.59 | 72.00 |
| *No. VIII.* | | | | | |
| As No. VII, but on western line | 31.0 | 23.20 | 15.80 | 1.55 | 68.10 |
| Reverse from above | 30.0 | 22.80 | 17.00 | 1.54 | 74.60 |
| **Mean** | 30.5 | 23.00 | 16.40 | 1.54 | 71.35 |
| **General mean** | ........ | 22.12 | 15.99 | 1.67 | 72.77 |

Following is a number of other combinations formed from the above:

| Combinations. | Solids in juice. | Sucrose in juice. | Glucose in juice. | Purity of juice. |
|---|---|---|---|---|
| Samples Nos.: | *Per ct.* | *Per cent.* | *Per cent.* | |
| I and II | 22.42 | 16.05 | 1.68 | 73.37 |
| I, II, III, and IV | 22.01 | 16.05 | 1.72 | 72.94 |
| III and IV | 22.10 | 16.03 | 1.75 | 72.50 |
| V, VI, VII, and VIII | 22.26 | 15.95 | 1.62 | 72.56 |
| I, II, V, VI, VII, and VIII | 22.32 | 15.97 | 1.64 | 72.83 |
| III, IV, VII, and VIII | 22.60 | 16.12 | 1.66 | 72.09 |

The samples which present the closest approximation to the general requirements are samples Nos. III and IV.

## EXPERIMENTS AT CALUMET PLANTATION (PATTERSON, LA.).

By F. E. Coombs.

The experiments with sorghum cane begun by Mr. Thompson on this plantation in 1889, and continued through 1890 and 1891, were still carried on during the summer and fall of 1892, following substantially the same lines of investigation as heretofore and with the employment of similar methods. Working always with the main object of securing the fittest varieties of sorghum for the locality, and bringing such varieties to a maximum of sugar-producing value by means of persistent selection of and breeding from individual canes of ascertained value, has resulted in the repeated introduction of new varieties for trial and in discarding sorts found lacking in what are accepted as essential qualities. Many varieties have now been tried patiently, none having been abandoned until further work upon them has been deemed useless and every opportunity given them of developing any valuable feature they might possess.

The primary function of the work at Calumet has been and must continue to be limited to the selection, at the earliest possible date and by the quickest means, of a variety of sorghum fitted to local conditions and needs—time and labor spent in continued culture of varieties not promising local success being, so far as attainment of this purpose is concerned, doubly wasted.

With each year the conclusion has become more and more apparent that the most direct road to success in securing a thoroughly good variety, of uniform quality and economic value, lies in the reduction of the number of varieties experimented with to one, or at most two, which shall have shown good qualities most steadily, and in focusing upon it or them, as the case may be, the same methods of selection previously employed in working with a larger number of varieties—that is to say, differentiating strain from strain in a single variety, and of these strains fixing and perpetuating, if possible, such as are best suited for sugar manufacture and to the local growth conditions.

In the work at Sterling, Kans., Mr. Denton has established the fact that among the whole number of plants arising from the seed of a single uncrossed head, but few usually retain all the characters distinguishing the parent plant, this being more particularly true of the chemical characteristics. But he has further ascertained, through study of the vast accumulation of data gathered by his station, that of several heads selected from a pedigreed plat, one or more will show a special capability of transmitting the salient features of the parent cane to nearly all of the canes of the second generation. In view of these facts, it seems that a careful system of breeding with a single fit variety will sooner establish the true maximum value which sorghum may maintain in any locality than when the work is divided over several varieties, and in the consequent multiplicity of detail the critical study of any one is hindered or obscured.

Therefore, in any further experiments with sorghum at this plantation, it is urgently recommended that, if practicable, a single variety shall be chosen and every effort made to secure its development until it shall have been conclusively shown, once for all, whether it can be regarded as a safe adjunct to the present cane fields, or whether it must be abandoned as attended by too many hazards to render its cultivation profitable in average seasons.

In thus working with a single variety, there will be avoided all danger of crosses, which is one of the drawbacks where several varieties are grown in the same field.

It should be very distinctly understood that the question is not now one entirely of sugar content or purity. Sorghum has been again and again grown at this place, from which sugar could have been extracted with simple clarification and by ordinary processes, and that profitably. The one important point—an absolute necessity—yet remains to be gained, and is that the sorghum grown for sugar-making shall retain the same standard of quality season after season—a fact now so familiar that it is not emphasized often enough and is in some danger of being overlooked.

By "sugar-producing value" should always be understood not the mere fact of more or less sucrose by polariscopic test, for the real value of any sugar plant to the manufacturer depends upon many other conditions, among which the more important are: (*a*) The quantity of sucrose which can be secured from the juice as merchantable product by methods which can not profitably exceed a certain moderate cost; (*b*) a sufficiently heavy tonnage to furnish a certain profit to the cultivator whether he be proprietor or tenant; (*c*) a form which will permit adequate cleaning of the canes, mechanically or by hand, with a minimum expenditure of power or time; (*d*) finally, ability to sustain sugar content and purity of juice, and to remain free from offshoots for a period sufficient to allow for unavoidable delays in harvesting.

In the past four years of cultivation here there has been found a variety of sorghum which seems signally adapted to local conditions, and one which, by its physical characters as well as its chemical qualities, is admirably fitted to be made the subject of a final series of tests, such as have been outlined; and it is not too much to say that if it does not fulfill its present promise it is probable that the search for a better cane will entail an outlay of time and money not warranted in view of the examination already of so many varieties which have one by one failed to realize the hopes with which they were introduced. The variety alluded to is known here and at Sterling as Colman.

It must never be forgotten that the variability of sorghum, upon which is founded its best hope for improvement by artificial selection, is recognized also as the factor most inimical to the stability of valuable strains when acquired, and this circumstance must always be taken into account by the experimenter, and must govern his methods.

A growing sense of the unreliability attaching to estimates of the comparative size of different varieties of sorghum, based on examination by the eye, and in the field, and the knowledge that the juice yield is not commonly a safe criterion, led, this season, to a system of weighing each sample of cane brought in, whether for selection work or as an average sample, cleaning, with the exception of seed tops in the first instance, and completely in the second, and recording the total number of canes and the total weight of clean cane. The error introduced in the selection plats by including the seed tops was considerable, but could not be avoided.

In the work of 1892 one change was made in the routine which affects the summary of the analyses of single canes, this being a more exacting preliminary spindle selection than formerly followed, which restricted the number of polarizations. This change threw out many juice samples that would have given sucrose above 16, and purity above 77, and certain comparative tables, heretofore given, are from this cause made impracticable, but the large number of canes to be examined made rapid work imperative.

## CULTURAL WORK, 1892.

For the sorghum plats of 1892 land was selected in a field lying opposite and across the public road from Mr. Thompson's residence, a situation chosen on account of easy access and convenience of water supply, should need of irrigation occur. Preparation was made for this contingency by leading a pipe from a windmill tank near the house.

The land used was in that part of the plantation which had been longest under cultivation, had not been dressed with stable manure for more than twenty years, and was as well drained and light in texture as any on the place. This was in a crop of very poor second year "ratoon" cane at the time selected, and on November 10 the whole field was plowed in anticipation of its use for the sorghum experiments.

A dry winter failed to rot the cane stubble, and when, on the 10th of

March following, the final plowing was done, the 11th and 12th were spent in harrowing, and these clods were removed by hand. The plats were then staked off, and on March 14 the single head and field plats of the first series were seeded by hand as always before. For the second series of plats the land was prepared May 2 by a double harrowing and deep plowing and working of the rows, and on the 3d another harrowing was given and the drills opened and seeded immediately after.

The varieties cultivated at Calumet in 1892 were the following: Colman, Collier (formerly grown here as "Undendebule"), Planter, Link, Early, Late, and Improved Orange, Ubehlana, McLean, Variety No. 208, Cross No. 8X (Sterling, Kans., numbers, of 1891), and two "sport" or crossed varieties, both from Red Liberian stock, and designated, for convenience, as Red Liberian Special and Calumet Mammoth.

Of the varieties enumerated, special attention was paid to four—Colman, Collier, Link, and Planter—sixteen single head (selection) plats, and two field (average sample) plats being planted with each. To avoid needless detail, it may be said that the arrangement of rows was substantially as in 1891, alternating those of first and second planting and late and early varieties to minimize the risk of crossing.

## FIRST SERIES.

In this planting, made March 14 as stated, all the above varieties were represented excepting McLean and varieties 208 and 8X. From this date to the 24th the weather was cold and cloudy, with a minimum temperature ranging from 27° to 63° F., and a total rainfall of 1½ inches. On the nights of the 18th, 19th, and 20th ice formed. Cool weather prevailed until about April 20, at which date there had been twenty-six days without rain since the day of planting, and irrigation was resorted to and surface cultivation given as needed. From April 20 to May 1 the temperature rose rapidly and growth was accelerated, aided by the 8⅞ inches of rainfall recorded during this period.

With the exception of two, reserved by Mr. Thompson for a special experiment detailed later, all the single-head plats of the first planting were desuckered on May 4, the tillers being removed by hand. Favorable and warm weather continued until the end of the month, when want of rain made a second irrigation necessary. This dryness continued until June 10 with increasing heat, when rain set in lasting until July 11, and giving for the thirty days a measured precipitation of 27⅞ inches, yet this with daily intervals of bright, hot sunshine, which prevented damage from blight. From this time until the middle of September high temperature and timely rains afforded good weather conditions. Selection work upon this series was begun about July 25, and closed in early September.

Some injury was sustained by the sorghum of this series from attacks of burrowing larvæ and plant lice, which began about April 20, but caused no permanent visible harm to the canes. The plats of the second series, planted May 3, suffered severely, however, and a large proportion of the canes was destroyed.

"Red disease" was noticed in this series only in the plats of Ubehlana, Improved, and Late Orange, and to a slight degree in Early Orange. Canes showing this fault (always apparent in the red-brown color of the juice) were never analyzed, and little analytical work was done with plats so affected. No lodging occurred.

The first series comprised the following:

*Selection plats from single heads.*

| Variety. | Plat No.— | Variety. | Plat No.— |
|---|---|---|---|
| Colman | 18, 19, 39, 40, 60, 61, 81, 82. | Ubehlana | 45, 46. |
| Collier | 14, 15, 35, 36, 56, 57, 77, 78. | Improved Orange | 64. |
| Planter | 10, 11, 31, 32, 52, 53, 73, 74. | Late Orange | 43. |
| Calumet Mammoth | 9, 30, 51, 72. | Early Orange | 1, 22. |
| Link | 5, 6, 26, 27, 47, 48, 68, 69. | Red Liberian Special | 3. |

*Field plats from mixed selected seeds.*

| Variety. | Plat— | Variety. | Plat— |
|---|---|---|---|
| Colman | A. | Collier | E. |
| Link | C. | Planter | G. |

In general the plats of this series were successful, from the grower's point of view, the stand secured and the size of the canes produced being satisfactory. From the chemical standpoint, varieties of the first planting were also gratifying in their results. In both regards this planting was far superior to that of later date.

Plats 9, 30, 51, and 72, "Calumet Mammoth," were from plat No. 27 of 1891, grown from a sport or crossed cane of unusual size and appearance found in a plat of Red Liberian in 1890. The size was less notable this season than last, and very woody, pithy canes were produced. On the best appearing plat of this variety sufficient analytical work was done to demonstrate its lack of any value. In case of plat No. 3, "Red Liberian Special," the few analyses performed resulted in dropping the variety from further experiment.

Ubehlana, Early, Late, and Improved Orange were examined with due care, but the result was a decision to discontinue their cultivation. Hence no extended description of the plats of these six varieties need be entered upon, and the space thus gained may be devoted to the remaining four—Colman, Collier, Link, and Planter.

### *Colman.*

(All 1892 plats of this variety were derived from Calumet plat D, 1891.)

*Plat No. 18.*—Analysis of parent cane, serial No. 480, 1891, cut on the one hundred and sixty-seventh day: Sucrose, 18.2; purity, 80.5. Best single stalk of derivate plat, serial No. 217, 1892, cut on the one hundred and fifty-seventh day: Sucrose, 19.2; purity, 80.3. A good stand of canes, of uniform type and size. Of 211 canes, only 8 passed the Brix table, and no seed were saved. Average weight per cane, 211 canes weighed, 1.97 pounds.

*Plat No. 19.*—Analysis of parent cane, serial No. 407, 1891, cut on the one hundred and sixty-third day: Sucrose, 19.9; purity, 80.6; glucose, 0.6; nonsugars, 4.2. Best single stalk of derivate plat, serial No. 98, 1892, cut on the one hundred and forty-third day: Sucrose, 20; purity, 83.7; glucose, 0.6; nonsugars, 3.3. Canes of remarkably uniform type and size, and of perfect stand. The parent cane was the second choice among all the canes selected from plat D, 1891. In the laboratory canes from this plat gave uniformly high analyses, and from among them should be chosen the seed for future planting. Average weight per clean cane, but including seed head, 215 canes weighed, 1.06 pounds.

*Plat No. 39.*—Analysis of parent cane, serial No. 481, 1891, cut on the one hundred and sixty-seventh day: Sucrose, 18; purity, 80.5. Best single stalk of derivate plat, serial No. 61, 1892, cut on the one hundred and forty-first day: Sucrose, 16.1; purity, 80.9. Examinations made on samples of 10 canes each, on two occasions, did not give results warranting selection work. Average weight per cane, 254 canes weighed, 0.88 pound.

*Plat No. 40.*—Analysis of parent cane, serial No. 486, 1891, cut on the one hundred and sixty-seventh day: Sucrose, 18.4; purity, 82.2; glucose, 0.6; nonsugars, 3.3. Best single stalk of derivate plat, serial No. 28, 1892, cut on the one hundred and thirty-fifth day: Sucrose, 17.6; purity, 85.4; glucose, 0.9; nonsugars. 2.4. As in No. 40, no selections were made from these canes. Average weight per cane, 258 canes weighed, 0.94 pound.

*Plat No. 60.*—Analysis of parent cane, serial No. 483, 1891, cut on the one hundred and sixty-seventh day: Sucrose, 18; purity, 79.8. Best single stalk of derivate plat, serial No. 106, 1892, cut on the one hundred and forty-fourth day: Sucrose 17.8; purity, 80.5. No selections were made from this plat. Average weight per cane, 30 canes weighed, 1.13 pounds.

*Plat No. 61.*—Analysis of parent cane, serial No. 408, 1891, cut on the one hundred and sixty-third day: Sucrose, 18.6; purity, 78.2. Best single stalk of derivate plat, serial No. 110, 1892, cut on the one hundred and forty-fourth day: Sucrose, 18.8; purity, 81.4. In two instances canes were found which gave sucrose of 18.9, but with purity of only 80.4. A few heads were saved from this plat, but will probably not be planted. Average weight per cane, 204 canes weighed, 0.83 pound.

*Plat No. 81.*—Analysis of parent cane, serial No. 485, 1891, cut on the one hundred and sixty-seventh day: Sucrose, 17.9; purity, 80.8. Best single stalk of derivate plat, serial No. 228, 1892, cut on the one hundred and fifty-seventh day: Sucrose, 20.2; purity, 83.5; glucose, 0.6; nonsugars, 3.4. This plat ranked with No. 19 as one of the preëminently best of the series and of the whole season's selection plats. The stand was not quite so good as in No. 19, however, nor was the uniformity of type so complete, 2 or 3 canes widely differing from Colman type being noted and destroyed. Average weight per cane, 156 canes weighed, 1.80 pounds.

*Plat No. 82.*—Analysis of parent cane, serial No. 403, 1891, cut on the one hundred and sixty-third day: Sucrose, 18.5; purity, 78.1. Best single stalk of derivate plat, serial No. 88, 1892 (only cane analyzed), cut on the one hundred and forty-second day: Sucrose, 17.9; purity, 81.4. Ninety-five canes from this plat were ground, and but 1 attained the required Brix standard (22°). Average weight per cane, 203 canes weighed, 0.88 pound.

It will be observed, on examination of the figures given for the foregoing plats, that the best canes in 1892 were found to be from fifteen to twenty days earlier than the parent canes from which derived, the latter, of course, being selections from the best found in plat D of 1891. This is probably due to the retarded maturity of the first series of plats of 1891, which was caused by early drought. An interesting and hopeful fact brought out in the foregoing figures is that, as a rule, the heavier canes gave the best analyses. The stand was satisfactory in all and excellent in most of the Colman plats of this series.

*Link.*

*Plat No. 5.*—Derived from Calumet plat No. 10, 1891. Analysis of parent cane, serial No. 622, 1891, cut on the one hundred and twelfth day: Sucrose, 16.9; purity, 81.4; glucose, 0.6; nonsugars, 3.2. Best single stalk of derivate plat, serial No. 93, 1892, cut on the one hundred and forty-third day: Sucrose, 18.1; purity, 82.3. Canes uniform in type and size, but notably small quantity of seed produced. Average weight per cane, 261 canes weighed, 0.84 pound.

*Plat No. 6.*—(By the forty-eighth day from planting, only 27 canes had come up. All these were stunted and badly diseased. No analytical work was attempted, and the plat was abandoned.)

*Plat No. 26.*—Derived from Calumet plat No. 10, 1891. Analysis of parent cane, serial No. 597, 1891, cut on the one hundred and ninth day: Sucrose, 17.2; purity, 80.1; glucose, 0.9; nonsugars, 3.3. Best single stalk of derivate plat, serial No. 153, 1892, cut on the one hundred and forty-ninth day: Sucrose, 17.3; purity, 81.2. Type and size fairly uniform. Laboratory results not particularly good. Average weight per cane, 207 canes weighed, 0.92 pound.

*Plat No. 27.*—Derived from Calumet plat No. 9, 1891. Analysis of parent cane, serial No. 177, 1891, cut on the one hundred and forty-ninth day: Sucrose, 18.5; purity, 80.6; glucose, 0.5; nonsugars, 3.9. Best single stalk of derivate plat, serial No. 156, 1892, cut on the one hundred and forty-ninth day: Sucrose, 17.9; purity, 82.9. Uniform as to type and size of canes, but not much seed produced. Average weight per cane, 91 canes weighed, 0.99 pound.

*Plat No. 47.*—Derived from Calumet plat No. 10, 1891. Analysis of parent cane, serial No. 771, 1891, cut on the one hundred and twenty-fourth day: Sucrose, 16.3; purity, 79.1; glucose, 0.6; nonsugars, 3.7. Best single stalk of derivate plat, serial No. 105, cut on the one hundred and forty-third day: Sucrose, 17.9; purity, 81.7. Of 38 single canes, ground at three separate dates, only three juices were polarized, these not reaching the required Brix standard, but examined as being nearest it. Average weight per cane, 326 canes weighed, 0.58 pound.

*Plat No. 48.*—Derived from Calumet plat No. 6, 1891. Analysis of parent cane, serial No. 814, 1891, cut on the one hundred and twenty-seventh day: Sucrose, 16.4; purity, 80; glucose, 0.7; nonsugars, 3.5. Best single stalk of derivate plat, serial No. 67, 1892, cut on the one hundred and forty-first day: Sucrose, 16.6; purity, 81.4. Canes fell as far below Brix standard as in No. 47, and little analytical work was done. Average weight per cane, 241 canes weighed, 0.75 pound.

*Plat No. 68.*—Derived from Calumet plat No. 10, 1891. Analysis of parent cane, serial No. 818, 1891, cut on the one hundred and twenty-seventh day: Sucrose, 16.2; purity, 79.1; glucose, 0.9; nonsugars, 3.4. A plat of fairly uniform type and size of canes. By Mr. W. J. Thompson's desire, this plat (together with plat No 73, Planter) was reserved for a special experiment upon the effect of removing tillers (or suckers from the rootstock). The method and result of this work is given separately in a subsequent page.

*Plat No. 69.*—Derived from Calumet plat No. 6, 1891. Analysis of parent cane, serial No. 810, 1891, cut on the one hundred and twenty-seventh day: Sucrose, 15.9; purity, 79.3; glucose, 0.8; nonsugars, 3.4. Best single stalk of derivate plat, serial No. 80, 1892, cut on the one hundred and forty-second day: Sucrose, 17.6; purity, 81.5. Fair uniformity in type and size. Average weight per cane, 229 canes weighed, 0.72 pound.

As a rule, wherever the canes of the derivate plats of Link show the same date of maturity as the parent canes, the parent plat will be found to have been of the first series of 1891; and when later the parent plat will be found in the second series of that year. All the foregoing plats of this variety were of the characteristic tall, slender form, and the unfortunate proneness to sprouting from the joints, which is one of its most serious objections—if only as interfering with proper cleaning and topping. From two to three supplemental panicles usually have begun to form seed before the central panicle has ripened its own. Few seed were produced by the variety this season, and one or two plats had a large ratio of barren seed tops. Plats derived from Calumet plats 9 and 10 of 1891 were from heads received that season from Sterling. Calumet plats 5 and 6 of 1891 were from stock brought to this plantation from Sterling in 1889.

### *Collier.*

*Plat No. 14.*—Derived from Calumet plat No. 39, 1891. Analysis of parent cane, serial No. 324, 1891, cut on the one hundred and fifty-sixth day: Sucrose, 20.6; purity, 82.1; glucose, 0.5; nonsugars, 4. Best single stalk of derivate plat, serial No. 45, 1892, cut on the one hundred and fortieth day: Sucrose, 18.7; purity, 85; glucose, 0.4; nonsugars, 2.9. A good plat as to stand and uniformity of type, and one of the best, chemically, of its variety.

The effect of liming was tried upon this plat. A stake was driven at the center of the row, and to one-half of the plat lime (dry slaked) was applied in the proportion of 3,000 pounds per acre, calculated for 7-foot rows. On two days of the selection work an equal number of canes from each side of the stake was ground and the analyses were entered as made upon limed and unlimed samples. The result was as follows, cane weights including seed tops:

| | Limed half. | | Unlimed half. | |
|---|---|---|---|---|
| | Aug. 1. | Aug. 11. | Aug. 1. | Aug. 11. |
| Canes ground | 5 | 30 | 5 | 30 |
| Average weight, one cane ........pounds.. | 1.2 | 1 | 1 | 1 |
| Average sucrose ........per cent.. | 17.1 | 17.6 | 17.7 | 17.9 |
| Average purity | 80.3 | 78.9 | 82.2 | 79.6 |

The above figures show nothing conclusive, merely giving a very slight advantage in favor of the unlimed half of the plat, not greater than the difference ordinarily found between two samples taken at the same time and in the same way from a homogeneous plat of sorghum. The little real utility of such experiments on so small a scale can not be too strongly insisted upon, since if their result is confirmatory of a preformed theory, such erroneous verification is too often accepted, while if confirmation is not given nothing is easier than to retain the theory and reject the evidence on its palpable insufficiency. Average weight per cane for plat as a whole, 241 canes weighed, 0.85 pound.

*Plat No. 15.*—Derived from Calumet plat No. 8, 1891. Analysis of parent cane, serial No. 606, 1891, cut on the one hundred and tenth day: Sucrose, 19.5; purity, 82.4; glucose, 0.6; nonsugars, 3.6. Best single stalk of derivate plat, serial No. 96, 1892, cut on the one hundred and forty-third day: Sucrose, 17.9; purity, 84. Canes uniform in type and size. This plat, with three others, was the subject of experiment as to comparative analysis of seedling canes and the tillers produced by them. A misunderstanding resulted in the destruction of nearly all the tillers in these plats, and no reliable data were secured. Average weight per cane, 48 canes weighed, 0.80 pound.

*Plat No. 35.*—Derived from Calumet plat No. 39, 1891. Analysis of parent cane, serial No. 325, 1891, cut on the one hundred and fifty-sixth day: Sucrose. 20.5; purity, 81.6; glucose, 0.5; nonsugars, 4.2. Best single stalk of derivate plat, serial No. 59, 1892, cut on the one hundred and forty-first day: Sucrose, 17.7; purity, 82. Fairly uniform in type and size and a fairly good stand. Average weight per cane, 216 canes weighed, 0.67 pound.

*Plat No. 36.*—Derived from Calumet plat No. 8, 1891. Analysis of parent cane, serial No. 581, 1891, cut on the one hundred and seventh day: Sucrose, 19.5; purity, 82.4; glucose, 0.5; nonsugars, 3.7. Best single stalk of derivate plat, serial No. 60, 1892, cut on the one hundred and forty-first day: Sucrose, 17.5; purity, 81.8. A good stand of perfectly uniform canes. Little analytical work was done with this plat. Average weight per cane, 282 canes weighed, 0.61 pound.

*Plat No. 56.*—Derived from Calumet plat No. 39, 1891. Analysis of parent cane, serial No. 331, 1891, cut on the one hundred fifty-sixth day: Sucrose, 19.7; purity, 82.1; glucose, 0.5; nonsugars, 3.9. Best single stalk of derivate plat, serial No. 161, 1892, cut on the one hundred and forty-ninth day: Sucrose, 18.3; purity, 81.3. Very uniform as to type and reasonably so in size. Very good stand. This was one of the better plats of Collier in the laboratory. Average weight per cane, 187 canes weighed, 0.71 pound.

*Plat No. 57.*—Derived from Calumet plat No. 8, 1891. Analysis of parent cane, serial No. 555, 1891, cut on the one hundred and fifth day: Sucrose, 19.6; purity, 81.6; glucose, 0.4; nonsugars, 4.1. Best single stalk of derivate plat, serial No. 73, 1892, cut on the one hundred and forty-first day: Sucrose, 17.5; purity, 80.6. A very good stand of canes, uniform in type and size. Little analytical work was done with this plat. Average weight per cane, 244 canes weighed, 0.64 pound.

*Plat No. 77.*—Derived from the Calumet plat No. 39, 1891. Analysis of parent cane, serial No. 151, 1891, cut on the one hundred and forty-seventh day: Sucrose, 19.3; purity, 82.1; glucose, 0.5; nonsugars, 3.7. Best single stalk of derivate plat, serial No. 83, 1892, cut on the one hundred and forty-second day: Sucrose, 18.1; purity, 81.5. Uniformity marked only in type. Very poor laboratory record. Average weight per cane, 241 canes weighed, 0.60 pound.

*Plat No. 78.*—Derived from Calumet plat No. 8, 1891. Analysis of parent cane, serial No. 670, 1891, cut on the one hundred and seventeenth day: Sucrose, 18.8; purity, 81.7; glucose. 0.4; nonsugars, 3.8. Best single stalk of derivate plat, serial No. 84, 1892, cut on the one hundred and forty-second day: Sucrose, 17.9; purity, 82.1. Uniform in type, but irregular and small in size. Stand rather below average for this series. Average weight per cane, 282 canes weighed, 0.52 pound.

The variety represented in the foregoing plats gave fairly good to excellent laboratory results. It was also noted that the seed produced was greater in quantity than ever previously at Calumet, although it has never been a variety giving much seed.

The small size of these canes, as clearly shown by the figures given, is a drawback to Collier in this locality. While admitting that the light panicle has lowered the average weight per cane in this variety, it will not do to overrate this circumstance.

### *Planter.*

(All the selection plats of this variety in 1892 were derived from canes grown in Calumet plat No. 15 of 1891.)

*Plat No. 10.*—Analysis of parent cane, serial No. 437, 1891, cut on the one hundred and sixty-fourth day: Sucrose, 18.5; purity, 80.2; glucose, 1.1; nonsugars, 3.5. Best single stalk of derivate plat, serial No. 95, 1892, cut on the one hundred and forty-third day: Sucrose, 17.7; purity, 81.6. A fair stand was secured, the canes being uniform in type and size. Average weight per cane, 183 canes weighed, 0.95 pound.

*Plat No. 11.*—Analysis of parent cane, serial No. 344, 1891, cut on the one hundred and fifty-seventh day: Sucrose, 19.8; purity, 82.4; glucose, 1.2; nonsugars, 3.1. Best single stalk of derivate plat, serial No. 40, 1892, cut on the one hundred and fortieth day: Sucrose, 16.6; purity, 79.0. Poor analytical results and little laboratory work done with this plat. Average weight per cane, 250 canes weighed, 0.77 pound.

*Plat No. 31.*—Analysis of parent cane, serial No. 438, 1891, cut on the one hundred and sixty-fourth day: Sucrose, 19.5; purity, 80.2; glucose, 1.2; nonsugars, 3.6. Best single stalk of derivate plat, serial No. 56, 1892, cut on the one hundred and fortieth day: Sucrose, 17.0; purity, 80.2. Good stand and uniform type, but very low analyses. Average weight per cane, 213 canes weighed, 0.90 pound.

*Plat No. 32.*—Analysis of parent cane, serial No. 363, 1891, cut on the one hundred and fifty-eighth day: Sucrose, 20.1; purity, 81.4; glucose, 0.9; nonsugars, 3.7. Best single stalk of derivate plat, serial No. 27, 1892, cut on the one hundred and thirty-fifth day: Sucrose, 17.5; purity, 81.4. Perfect stand. Canes fairly uniform in type, entirely so in size. Poor average laboratory record. Average weight per cane, 247 canes weighed, 0.81 pound.

*Plat No. 52.*—Analysis of parent cane, serial No. 306, 1891, cut on the one hundred and fifty-fourth day: Sucrose, 19.2; purity, 79.7; glucose, 1.5; nonsugars, 3.4. Best single stalk of derivate plat, serial No. 69, 1892, cut on the one hundred and forty-first day: Sucrose, 17.9; purity, 83.2. But one day's selection work was done with this plat, and the analysis cited is one of the two canes which from ten attained the Brix requirement. The second cane gave: Sucrose 16.3 and purity 78.7. Uniform in type and size. Average weight per cane, 10 canes weighed, 1.15 pounds. It should be noted that the best stalks, physically, have been regularly the first selected, which usually will explain the higher average weight when but few canes are weighed.

*Plat No. 53.*—Analysis of parent cane, serial No. 350, 1891, cut on the one hundred and fifty-seventh day: Sucrose, 19.4; purity, 81.2; glucose, 1.3; nonsugars, 3.2. Best of the only two single stalks analyzed in derivate plat, serial No. 70, 1892, cut on the one hundred and forty-first day: Sucrose, 16.3; purity, 79.5. Uniform in type and size, and of good stand. Average weight per cane, 186 canes weighed, 0.80 pound.

*Plat No. 73.*—Analysis of parent cane, serial No. 361, 1891, cut on the one hundred and fifty-eighth day: Sucrose, 18.6; purity, 79.4; glucose, 1.4; nonsugars, 3.4. This plat was used for an experiment upon desuckering, with plat No. 58, Link, and the result is given in Table IX, later.

*Plat No. 74.*—Analysis of parent cane, serial No. 349, 1891, cut on the one hundred and fifty-seventh day: Sucrose, 19.2; purity, 81.8; glucose, 1.3; nonsugars, 3.5. Best of the (only) two analyses of derivate plat, serial No. 115, 1892, cut on the one hundred and forty-fourth day: Sucrose, 17.6; purity, 78.9. Uniform in type, rather irregular in size. Of 30 canes Brixed, 2 passed spindle test. Average weight per cane, 195 canes weighed, 0.73 pound.

In any comparisons between the varieties represented in the foregoing series of plats, and in fixing the relative value of different plats of each variety, recourse must be had to the relative number of canes which passed the Brix table, or the ratio of this number to the total number of canes ground. For, owing to the unusually high Brix standard set, to the fact that this standard varied as the quality of the canes in each plat permitted more or less rigid exclusions, and to the fact that the greater proportion of work was devoted to the plats of best promise, there remains no fairer means of comparison than this available, which itself leaves much to be desired.

TABLE XXXIII.—*Comparison of plats, single stalks, first series.*

COLMAN.

| | Plat number. | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 18. | 19. | 39. | 40. | 60. | 61. | 81. | 82. |
| Number canes ground | 211 | 198 | 20 | 20 | 30 | 204 | 156 | 95 |
| Per cent reaching Brix standard | 3.79 | 12.12 | 10.00 | 25.00 | 13.30 | 6.37 | 14.74 | 1.05 |
| Average sucrose, all analyses | 17.40 | 19.10 | 15.60 | 17.80 | 17.60 | 18.10 | 19.40 | 17.90 |
| Average purity, all analyses | 77.90 | 82.70 | 78.60 | 82.80 | 79.90 | 80.70 | 81.70 | 81.40 |
| Average nonsugars, all analyses | 3.50 | 3.50 | ........ | 2.40 | ........ | 2.90 | 3.60 | ...... |
| Average weight per cane...pounds | .97 | 1.06 | .88 | .94 | 1.13 | .83 | 1.80 | .88 |

TABLE XXXIII.—*Comparison of plats, single stalks, first series*—Continued.

LINK.

| | Plat number. | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 5. | *6. | 26. | 27. | 47. | 48. | †68. | 69. |
| Number canes ground | 59 | ........ | 40 | 40 | 38 | 20 | ........ | 85 |
| Per cent reaching Brix standard | 11.95 | ........ | 10.00 | 10.00 | 7.89 | 10.00 | ........ | 7.00 |
| Average sucrose, all analyses | 17.30 | ........ | 16.90 | 17.30 | 17.20 | 16.20 | ........ | 16.30 |
| Average purity, all analyses | 80.00 | ........ | 80.50 | 78.84 | 81.60 | 80.80 | ........ | 80.00 |
| Average nonsugars, all analyses | 3.30 | ........ | ........ | ........ | ........ | ........ | ........ | ........ |
| Average weight per cane...pounds | .84 | ........ | .92 | .99 | .58 | .75 | ........ | .72 |

* Plat destroyed.

† No selection work.

COLLIER.

| | 14. | 15. | 35. | 36. | 56. | 57. | 77. | 78. |
|---|---|---|---|---|---|---|---|---|
| Number canes ground | 80 | 35 | 50 | 49 | 140 | 110 | 117 | 135 |
| Per cent reaching Brix standard | 22.50 | 11.43 | 10.00 | 6.12 | 5.00 | 1.82 | 2.56 | 2.96 |
| Average sucrose, all analyses | 17.60 | 17.20 | 17.40 | 17.50 | 17.80 | 16.99 | 17.60 | 17.40 |
| Average purity, all analyses | 79.60 | 81.80 | 80.20 | 81.10 | 80.90 | 77.30 | 79.30 | 79.30 |
| Average nonsugars, all analyses | 3.10 | ........ | ........ | ........ | ........ | ........ | ........ | ........ |
| Average weight per cane...pounds | .85 | .80 | .67 | .61 | .71 | .64 | .60 | .52 |

PLANTER.

| | 10. | 11. | 31. | 32. | 52. | 53. | 73.† | 74. |
|---|---|---|---|---|---|---|---|---|
| Number canes ground | 183 | 50 | 69 | 110 | 10 | 10 | ........ | 30 |
| Per cent reaching Brix standard | 6.55 | 12.00 | 8.69 | 9.09 | 20.00 | 20.00 | ........ | 6.67 |
| Average sucrose, all analyses | 17.10 | 16.60 | 15.20 | 16.60 | 17.10 | 16.40 | ........ | 17.30 |
| Average purity, all analyses | 76.60 | 76.60 | 71.90 | 76.10 | 80.90 | 78.80 | ........ | 79.20 |
| Average nonsugars, all analyses | ........ | ........ | ........ | ........ | ........ | ........ | ........ | ........ |
| Average weight per cane...pounds | .95 | .77 | .90 | .81 | 1.15 | .80 | ........ | .73 |

† No selection work.

TABLE XXXIV.—*Comparison of varieties, based on Table I.*

[In this table the per cent of canes reaching Brix standard is omitted, not being a comparable factor since the standard varied with different varieties.]

| | Colman. | Links'. | Collier. | Planter's Friend. |
|---|---|---|---|---|
| Average sucrose, all analyses...per cent | 18.5 | 16.9 | 17.5 | 16.5 |
| Average purity, all analyses | 81.4 | 80.1 | 80.0 | 76.2 |
| Average nonsugars, all analyses...per cent | 3.2 | ........ | 3.1 | ........ |
| Average weight per cane...pound | .95 | .76 | .65 | .82 |

Inspection of Table XXXIII will show, in the plats of Colman, the evident superiority of Nos. 19 and 81. From these two plats have been selected the seed heads from which all plats of this variety would best be grown in 1893.

In Table XXXV, the reason for preference of Colman to the other three varieties is clear. Collier, it will be noted, gave very excellent laboratory results, but its very small stalk is against its value. Between Link and Planter, the choice is in favor of the former this season, while in the work of 1892 the order would have been the reverse.

TABLE XXXV.—*List and analyses of single heads, selected from plats 19 and 81, for planting in 1893.*

COLMAN.

| Plat No. 19. | | | | | | Plat No. 81. | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Serial No. | Date. | Days from planting. | Sucrose. | Purity. | Non-sugars. | Serial No. | Date. | Days from planting. | Sucrose. | Purity. | Non-sugars |
| | | | *Per ct.* | | *Per ct.* | | | | *Per ct.* | | *Per ct.* |
| 97 | Aug. 4 | 143 | 19.7 | 83.1 | ........ | 86 | Aug. 3 | 142 | 18.8 | 81.7 | 3.6 |
| 98 | Aug. 4 | 143 | 20.0 | 83.7 | 3.3 | 208 | Aug. 17 | 156 | 19.5 | 84.1 | 3.2 |
| 100 | Aug. 4 | 143 | 19.6 | 82.7 | 3.4 | 211 | Aug. 17 | 156 | 19.9 | 83.3 | 3.5 |
| 120 | Aug. 8 | 147 | 19.8 | 83.8 | ........ | 212 | Aug. 17 | 156 | 19.7 | 82.1 | 3.7 |
| 123 | Aug. 8 | 147 | 19.6 | 83.8 | ........ | 214 | Aug. 17 | 156 | 19.8 | 82.5 | 3.8 |
| 125 | Aug. 8 | 147 | 19.9 | 83.2 | 3.5 | 221 | Aug. 18 | 157 | 19.8 | 82.8 | 3.6 |
| 126 | Aug. 8 | 147 | 19.2 | 83.2 | ........ | 224 | Aug. 18 | 157 | 19.9 | 82.2 | 3.8 |
| 128 | Aug. 8 | 147 | 19.3 | 83.2 | ........ | 225 | Aug. 18 | 157 | 19.5 | 83.8 | ....... |
| 129 | Aug. 8 | 147 | 19.7 | 83.4 | ........ | 227 | Aug. 18 | 157 | 20.2 | 83.5 | 3.4 |
| 132 | Aug. 8 | 147 | 19.3 | 83.6 | ........ | 228 | Aug. 18 | 157 | 19.8 | 81.8 | ....... |
| 133 | Aug. 8 | 147 | 20.3 | 81.9 | 4.0 | | | | | | |
| 134 | Aug. 8 | 147 | 20.1 | 82.4 | 3.8 | | | | | | |
| 135 | Aug. 8 | 147 | 18.9 | 81.5 | ........ | | | | | | |
| 137 | Aug. 8 | 147 | 19.2 | 81.4 | ........ | | | | | | |
| 138 | Aug. 8 | 147 | 19.3 | 82.1 | 3.6 | | | | | | |
| 149 | Aug. 8 | 147 | 19.2 | 83.5 | ........ | | | | | | |

From plat No. 19, also, a large number of heads were saved from canes giving 18 per cent sucrose and over, and this seed will be used for planting such field plats as are needed.

### SECOND SERIES.

On May 3 the second series of plats was planted, duplicating all the varieties of the first series, and, in addition to them, one plat each of McLean, Variety No. 208, and Cross 8X, these three having been sent to Mr. Thompson from Sterling by Mr. A. A. Denton, with his recommendation. At the time of seeding this series, Mr. Thompson recorded warm weather, and soil in perfect condition as to moisture, etc.

Germination was for the most part good, but the stand suffered greatly, and many plats were quite destroyed by insects (burrowing larvæ and plant lice) before the canes were 8 inches tall, these insects seeming to leave the plats of the first series for the younger and tenderer plants of this.

Red disease occurred in the same varieties and to about the same extent in this as in the earlier planting.

Irrigation was employed on the 31st of May, excepting on plats 85, 86, and 87, and the field plats, all of which were separated from the selection plats by a deep ditch. After this the rains supplied the necessary moisture.

Agriculturally the series was a failure, although larger canes were produced as a rule, perhaps owing to the thin stand.

In the second series the plats were as follows:

*Selection plats from single heads.*

| Variety. | Plat. | Variety. | Plat. |
|---|---|---|---|
| Colman | 20, 21, 41, 42, 62, 63, 83, 84. | Late Orange | 44. |
| Collier | 16, 17, 37, 38, 58, 59, 79, 80. | Early Orange | 2, 23. |
| Planter | 12, 13, 33, 34, 54, 55, 75, 76. | Red Liberian Special | 4, 25 |
| Link | 7, 8, 28, 29, 49, 50, 70, 71. | McLean | 85. |
| Ubehlana | 46, 67. | Variety No. 208 | 86. |
| Improved Orange | 65. | CrossNo. 8X | 87. |

*Field plats from mixed selected seed.*

| Variety. | Plat. | Variety. | Plat. |
|---|---|---|---|
| Colman | B. | Collier | F. |
| Link | D. | Planter | H. |

The second planting was satisfactory neither in its field nor its laboratory record.

As in former series, descriptions of the various plats are given only for Colman, Link, Collier, and Planter, to which are added the three varieties received from Sterling.

### *Colman.*

(All plats of this variety were derived from Calumet plat D, of 1891.)

*Plat No. 20.*—Analysis of parent cane, serial No. 482, 1891, cut on the one hundred and sixty-seventh day: Sucrose, 18.5; purity, 81.6; glucose, 0.7; nonsugars, 3.5. Best single stalk of derivate plat, serial No. 387, 1892, cut on the one hundred and thirty-fifth day: Sucrose, 17.8; purity. 79.8; glucose, 0.5; nonsugars, 4. Type and size quite uniform, stand not above 30 per cent. Average weight per cane, 39 canes weighed, 1.56 pounds.

*Plat No. 21.*—Analysis of parent cane, serial No. 478, 1891, cut on the one hundred and sixty-seventh day: Sucrose, 19.5; purity, 82.6; glucose, 0.6; nonsugars, 3.5. Best single stalk of derivate plat, serial No. 390, 1892, cut on the one hundred and thirty-fifth day: Sucrose, 17.6; purity, 80.7; glucose, 0.5; nonsugars, 3.7. Uniform in type and size and of about 60 per cent stand. Average weight per cane, 67 canes weighed, 1.79 pounds.

*Plat No. 41.*—Analysis of parent cane, serial No. 411, 1891, cut on the one hundred and sixty-third day: Sucrose, 18.5; purity, 79.4. Best single stalk of derivate plat, serial No. 443, 1892, cut on the one hundred and fortieth day: Sucrose, 17.4; purity, 80.6. Type fairly, size entirely, uniform; stand poor, not over 25 per cent. Average weight per cane, 65 canes weighed, 1.69 pounds.

*Plat No. 42.*—Analysis of parent cane, serial No. 402, 1891, cut on the one hundred and sixty-third day: Sucrose, 19.9; purity, 80.1; glucose, 0.5; nonsugars, 4.4. Best single stalk of derivate plat, serial No. 399, 1892, cut on the one hundred and thirty-sixth day: Sucrose, 18.1; purity, 81.2; glucose, 0.6; nonsugars, 3.6. Quite uniform in type and fairly so in size of canes; stand as in Plat 41, not above 25 per cent. Average weight per cane, 65 canes weighed, 1.71 pounds.

*Plat No. 62.*—Analysis of parent cane, serial No. 488, 1891, cut on the one hundred and sixty-seventh day: Sucrose, 18.2; purity, 80.7. Best single stalk of derivate plat, serial No. 404, 1892, cut on the one hundred and thirty-sixth day: Sucrose, 18.3; purity, 79.2; glucose, 0.4; nonsugars, 4.4. Uniform as to type and size, stand not exceeding 20 per cent. Average weight per cane, 39 canes weighed, 1.56 pounds.

*Plat No. 63.*—Analysis of parent cane, serial No. 476, 1891, cut on the one hundred and sixty-seventh day: Sucrose, 19.1; purity, 81.1; glucose, 0.7; nonsugars, 3.8. Best single stalk of derivate plat, serial No. 410, 1892, cut on the one hundred and thirty-sixth day: Sucrose, 19.2; purity, 81; glucose, 0.6; nonsugars, 3.9. Quite uniform in type and fairly so in size. The best plat of this series. Nine seed heads saved, from which additions may be made to the seed selected from plats Nos. 19 and 81, if increased number of plats seems desirable. Average weight per cane, 44 canes weighed, 1.55 pounds.

*Plat No. 83.*—Analysis of parent cane, serial No. 416, 1891, cut on the one hundred and sixty-third day: Sucrose, 18.3; purity, 77.7. Best single stalk of derivate plat, serial No. 417, 1892, cut on the one hundred and thirty-sixth day: Sucrose, 19.4; purity, 81.2; glucose, 0.5; nonsugars, 4. The few canes which were secured gave very good results in the laboratory, but the plat was one of the poorest in stand, not more than 10 per cent. Type uniform, but size irregular. Average weight of one cane, 17 canes weighed, 1.71 pounds.

*Plat No. 84.*—Analysis of parent cane, serial No. 409, 1891, cut on the one hundred and sixty-third day: Sucrose, 19.1; purity, 78.6; glucose, 0.6; nonsugars, 4.6. Best single stalk of derivate plat, serial No. 421, 1892, cut on the one hundred and thirty-sixth day: Sucrose, 19; purity, 80.2; glucose, 0.5; nonsugars, 4.2. Fairly uniform in type and size, stand not more than 20 per cent. Average weight per cane, 29 canes weighed, 1.59 pounds.

### *Link.*

*Plat No. 7.*—Derived from Calumet plat No. 9, 1891. Analysis of parent cane, serial No. 135, 1891, cut on the one hundred and forty-seventh day: Sucrose, 18; purity, 89.8; glucose, 0.8; nonsugars, 1.3. Best single stalk of derivate plat, serial No. 331, 1892, cut on the one hundred and twenty-ninth day: Sucrose, 18.2; purity, 80.5; glucose, 0.6; nonsugar, 3.8. Very uniform in type; not so in size, stand not exceeding 25 per cent. While the parent cane was noted as having the highest purity and lowest nonsugar of any recorded at Calumet, not one cane of the derivate plat was analyzed in which either characteristic was prominent. In fact, the plant as a whole attained only a mediocre standard. Average weight per cane, 64 canes weighed, 1.48 pounds.

*Plat No. 8.*—Derived from Calumet plat No. 5, 1891. Analysis of parent cane, serial No. 256, 1891, cut on the one hundred and fifty-second day: Sucrose, 16.6; purity, 82.1; glucose, 0.7; nonsugars, 2.9. Best single stalk of derivate plat, serial No. 371, 1892, cut on the one hundred and thirty-fourth day: Sucrose, 15.3; purity, 77.7; glucose, 0.5; nonsugars, 3.9. Uniform in type and fairly regular in size; stand poor, not over 30 per cent. Laboratory record very poor. Average weight per cane, 20 canes weighed, 1.38 pounds.

*Plat No. 28.*—Derived from Calumet plat No. 9, 1891. Analysis of parent cane, serial No. 133, 1891, cut on the one hundred and forty-seventh day: Sucrose, 18.3; purity, 81.3; glucose, 0.6; nonsugars, 3.6. Best single stalk of derivate plat, serial No. 265, 1892, cut on the one hundred and fifteenth day: Sucrose, 17.3; purity, 80.5. Uniform in type and size; stand not above 10 per cent. Noted for barren panicles. Average weight per cane, 30 canes weighed, 1.47 pounds.

*Plat No. 29.*—Derived from Calumet plat No. 5, 1891. Analysis of parent cane, serial No. 427, 1891, cut on the one hundred and sixty-fourth day: Sucrose, 18.1; purity, 80.5; glucose, 0.6; nonsugars, 3.8. Best single stalk of derivate plat, serial No. 396, 1892, cut on the one hundred and thirty-fifth day: Sucrose, 15.4; purity, 77.2. Uniform in type and size. Stand not over 20 per cent. Average weight per cane, 40 canes weighed, 1.48 pounds.

*Plat No. 49.*—Derived from Calumet plat No. 9, 1891. Analysis of parent cane, serial No. 134, 1891, cut on the one hundred and forty-seventh day: Sucrose, 16.2; purity, 78.6; glucose, 1.0; nonsugars, 3.3. Best single stalk of derivate plat, serial

No. 275, 1892, cut on the one hundred and fifteenth day: Sucrose, 15,9; purity, 77.2. Fairly uniform in type, but quite irregular in size. Stand of but 10 per cent. Average weight per cane, 17 canes weighed, 1.35 pounds.

*Plat No. 50.*—Derived from Calumet plat No. 5, 1891. Analysis of parent cane, serial No. 260, 1891, cut on the one hundred and fifty-second day: Sucrose, 16.4; purity, 81.2; glucose, 0.7; nonsugars, 3.1. No analytical data secured from this plat. One sample of ten canes was ground without finding a juice of °B over 17. Average weight per cane, 197 canes weighed, 0.80 pound.

*Plat No. 70.*—No stand secured.

*Plat No. 71.*—No stand secured.

## *Collier.*

*Plat No. 16.*—Derived from Calumet plat No. 39, 1891. Analysis of parent cane, serial No. 322, 1891, cut on the one hundred and fifty-sixth day: Sucrose, 19.9; purity, 81.9; glucose, 0.6; nonsugars, 3.8. Best single stalk of derivate plat, serial No. 256, 1892, cut on the one hundred and fifteenth day: Sucrose, 18.1; purity, 80.4. Very great uniformity in type and size. Stand of about 45 per cent. Average weight per cane, 84 canes weighed, 0.98 pound.

*Plat No. 17.*—Derived from Calumet plat No. 7, 1891. Analysis of parent cane, serial No. 226, 1891, cut on the one hundred and fifty-first day: Sucrose, 19.0; purity. 83.6; glucose, 0.6; nonsugars, 3.2. Best single stalk of derivate plat, serial No. 319. cut on the one hundred and twentieth day: Sucrose, 18.3; purity, 78.5. Uniform in type, but of irregular size. The canes specially noted as suckering profusely. Stand not over 25 per cent. Average weight per cane, 29 canes weighed, 0.98 pound.

*Plat No. 37.*—Derived from Calumet plat No. 39, 1891. Analysis of parent cane serial No. 106, 1891, cut on the one hundred and forty-sixth day: Sucrose, 18.9; purity, 82.7; glucose, 0.6; nonsugars, 3.4. Best single stalk of derivate plat, serial No. 305, 1882, cut on the one hundred and nineteenth day: Sucrose, 17.8; purity, 79.1. Uniform in type and size, but the stand not more than 10 per cent. Average weight per cane, 38 canes weighed, 1.17 pounds.

*Plat No. 38.*—Derived from Calumet plat No. 7, 1891. Analysis of parent cane, serial No. 131, 1891, cut on the one hundred and forty-seventh day: Sucrose, 19.11; purity, 82.1; glucose, 0.5; nonsugars, 3.6. Best single stalk of derivate plat, serial No. 309, 1892, cut on the one hundred and nineteenth day: Sucrose, 18.9: purity, 79.7; glucose, 0.4; nonsugars,. 4.4. Uniform in type and size. Stand only 10 per cent. Average weight per cane, 35 canes weighed, 1.06 pounds.

*Plat No. 58.*—Derived from Calumet plat No. 39, 1891. Analysis of parent cane, serial No. 247, 1891, cut on the one hundred and fifty-first day: Sucrose, 19.3; purity, 81.7; glucose, 0.5; nonsugars, 3.8. Best single stalk of derivate plat, serial No. 311, 1892, cut on the one hundred and nineteenth day: Sucrose, 18.5; purity, 78.4; glucose, 0.6; nonsugars, 4.5. Uniform in type but not regular in size. Stand exceedingly poor, not over 5 per cent. Average weight per cane, 15 canes weighed, 1.30 pounds.

*Plat No. 59.*—Derived from Calumet plat No. 39, 1891. Analysis of parent cane, serial No. 318, 1891, cut on the one hundred and fifty-sixth day: Sucrose, 20.1; purity, 82.3; glucose, 0.6; nonsugars, 3.8. Best single stalk of derivate plat, serial No. 282, 1892, cut on the one hundred and fifteenth day: Sucrose, 17.9; purity, 77.1. Uniform in type and fairly regular in size. Stand about 10 per cent. Average weight per cane, 30 canes weighed, 0.98 pound.

*Plat No. 79.*—Stand to all intents *nil.*

*Plat No. 80.*—Derived from Calumet plat No. 39, 1891. Analysis of parent cane, serial No. 321, 1891, cut on the one hundred and fifty-sixth day: Sucrose, 19.9; purity, 82.1; glucose, 0.6; nonsugars, 3.8. Best single stalk of derivate plat, serial No. 381, 1892, cut on the one hundred and thirty-fourth day: Sucrose, 16.8; purity, 77.4; glucose, 0.6; nonsugars, 4.3. Uniform in type and of fairly regular size. Stand not more than 10 per cent. Average weight per cane, 20 canes weighed, 1.15 pounds.

### *Planter.*

(All plats of this variety were derived from Calumet plat No. 15, of 1891.)

*Plat No. 12.*—Analysis of parent cane, serial No. 346, 1891, cut on the one hundred and fifty-seventh day: Sucrose, 19.3; purity, 80.8; glucose, 1.1; nonsugars, 3.5. Best single stalk of derivate plat, serial No. 285, 1892, cut on the one hundred and eighteenth day: Sucrose, 18.7; purity, 80.9; glucose, 0.6: nonsugars. 3.8. Uniform in type and size. Stand about 30 per cent. Average weight per cane, 60 canes weighed, 1.38 pounds.

*Plat No. 13.*—Analysis of parent cane, serial No. 343, 1891, cut on the one hundred and fifty-seventh day: Sucrose, 19.7; purity, 83.0; glucose, 1.1; nonsugars, 2.9. Best single stalk of derivate plat, serial No. 286, 1892, cut on the one hundred and eighteenth day: Sucrose, 17.7; purity, 80.1. Type and size uniform. Stand about 75 per cent. Average weight per cane, 65 canes weighed, 1.12 pounds.

*Plat No. 33.*—Analysis of parent cane, serial No. 439, 1891, cut on the one hundred and sixty-fourth day: Sucrose, 19.5; purity, 79.7; glucose, 0.8; nonsugars, 4.2. Best single stalk of derivate plat, serial No. 350, 1892, cut on the one hundred and thirty-second day: Sucrose, 17.7; purity, 80.1; glucose, 0.6; nonsugars, 3.8. Uniform as to type, but of irregular size. Stand not more than 10 per cent. Average weight per cane, 20 canes weighed, 1.50 pounds.

*Plat No. 34.*—Analysis of parent cane, serial No. 342, 1891, cut on the one hundred and fifty-seventh day: Sucrose, 19.7; purity, 81.9; glucose, 1.0; nonsugars, 3.3. Best single stalk of derivate plat, serial No. 346, 1892, cut on the one hundred and thirty-second day: Sucrose, 17.3; purity, 79.0; glucose, 0.7; nonsugars, 3.9. Uniform in type and size. Stand very poor, not above 5 per cent. Average weight per cane, 19 canes weighed, 1.39 pounds.

*Plat No. 54.*—Practically no stand.

*Plat No. 55.*—Practically no stand.

*Plat No. 75.*—Analysis of parent cane, serial No. 125, 1891, cut on the one hundred and forty-sixth day: Sucrose, 17.8; purity, 78.4; glucose, 1.9; nonsugars, 3.0. Best single stalk of derivate plat, serial No. 352, 1892, cut on the one hundred and thirty-second day: Sucrose, 16.5; purity, 77.8—this analysis being one of the only two samples which passed the Brix table. Uniform in type, but very irregular in size of canes. Stand nearly nothing, about 3-4 per cent. Average weight per cane, 16 canes weighed, 1.03 pounds.

*Plat No. 76.*—No stand secured.

### *McLean.*

*Plat No. 85.*—Seed head without analysis, labeled "No. 21,227," received from Mr. Denton, Sterling, Kans. Best single stalk of derivate plat, serial No. 313, 1892, cut on the one hundred and nineteenth day: Sucrose, 18.1; purity, 79.0. Uniformity of type and size marked. Very tall, comparatively slender canes. Stand perfect. Laboratory results embrace examinations of nearly 300, but show no special superiority of the variety to Link, for example. Average weight per cane, 475 canes weighed, 0.80 pound.

### *Variety No. 208.*

*Plat No. 86.*—Derivation as above. Parent head was labeled "No. 23,312," and no analysis was furnished. Best single stalk of derivate plat, serial No. 361, 1892, cut on the one hundred and thirty-third day: Sucrose, 17.4; purity, 80.9; glucose, 0.5; nonsugars, 3.6. Fairly uniform in type and size. Stand perfect. Canes tall but slender, as in plat No. 85. Average weight per cane, 50 canes weighed, 1.50 pounds. Laboratory record only fair.

### *Cross No. 8X.*

*Plat No. 87.*—Derivation as in plats 85 and 86. Parent head was labeled "No. 23,538," Sterling, Kans., 1891, and no analysis was given. Best single stalk of derivate plat, serial No. 365, 1892, cut on the one hundred and thirty-third day: Sucrose, 16.2; purity, 77.9; glucose, 0.5; nonsugars, 4.1. Reasonably uniform canes as to type and size, with perfect stand. Very tall and handsome, but, like 85 and 86, seem comparatively slender. Laboratory record rather poor. Average weight per cane, 50 canes weighed, 1.30 pounds.

These three plats were grown on land joining that selected for the sorghum-field plats, and which had been dressed with cotton-seed meal for a crop of corn. A row of this corn was pulled up and the sorghum seed planted in its stead, and this may account for the vigorous growth and tallness of the canes produced, and, in some measure, for the rather low analyses.

In the following tables (XXXVI and XXXVII) comparison of the plats and varieties is made upon the same basis as employed for the first planting. The greatly diminished number of canes examined, however, and the less attention given to many of these plats because of their inferiority, impairs the validity of any general deductions which might be made.

TABLE XXXVI.—*Comparison of plats, single stalks, second series.*

COLMAN.

| Plat No | 20. | 21. | 41. | 42. | 62. | 63. | 83. | 84. |
|---|---|---|---|---|---|---|---|---|
| Number canes ground | 39 | 67 | 65 | 65 | 39 | 44 | 17 | 29 |
| Per cent reaching Brix standard | 12.82 | 14.93 | 12.31 | 10.77 | 23.08 | 25.00 | 23.53 | 13.79 |
| Average sucrose, all analyses..p. ct. | 17.60 | 17.20 | 17.30 | 17.80 | 17.80 | 18.80 | 18.90 | 18.60 |
| Average purity, all analyses | 79.70 | 79.40 | 79.50 | 80.50 | 79.10 | 79.50 | 81.00 | 79.70 |
| Average nonsugars, all analyses, p.ct. | 4.00 | 3.70 | ........ | 3.60 | 4.40 | 4.00 | 4.00 | 4.20 |
| Average weight per cane.......lbs. | 1.56 | 1.79 | 1.69 | 1.71 | 1.56 | 1.55 | 1.71 | 1.59 |

LINK.

| Plat No | 7. | 8. | 28. | 29. | 49. | 50. | 70.† | 71.† |
|---|---|---|---|---|---|---|---|---|
| Number canes ground | 64 | 20 | 30 | 40 | 17 | (*) | ........ | ...... |
| Per cent reaching Brix standard | 23.44 | 15.00 | 20.00 | 5.00 | 11.76 | (*) | ........ | ...... |
| Average sucrose, all analyses..p. ct. | 16.20 | 14.90 | 16.7 | 14.90 | 15.29 | (*) | ........ | ...... |
| Average purity, all analyses | 78.40 | 77.50 | 78.8 | 76.10 | 76.90 | (*) | ........ | ...... |
| Average nonsugars, all analyses, p.ct. | 3.70 | 3.90 | ........ | ........ | ........ | (*) | ........ | ...... |
| Average weight per cane.......lbs. | 1.48 | 1.38 | 1.47 | 1.45 | 1.35 | .80 | ........ | ...... |

* No selection work. † No stand secured.

COLLIER.

| Plat No | 16. | 17. | 37. | 38. | 58. | 59. | 79.* | 80. |
|---|---|---|---|---|---|---|---|---|
| Number canes ground | 65 | 29 | 38 | 35 | 15 | 30 | ........ | 20 |
| Per cent reaching Brix standard | 18.46 | 20.69 | 18.42 | 34.29 | 26.67 | 23.33 | ........ | 15.60 |
| Average sucrose, all analyses..p. ct. | 17.50 | 18.00 | 16.70 | 17.80 | 16.80 | 17.30 | ........ | 16.40 |
| Average purity, all analyses | 78.70 | 77.60 | 76.70 | 77.70 | 72.80 | 76.90 | ........ | 77.10 |
| Average nonsugars, all analyses, p.ct | ........ | ........ | 4.00 | 4.40 | 4.50 | 3.90 | ........ | 4.30 |
| Average weight per cane.......lbs. | .98 | .98 | 1.17 | 1.06 | 1.30 | .98 | ........ | 1.15 |

* No stand secured.

**Table XXXVI.**—*Comparison of plats, single stalks, second series*—Continued.

PLANTER.

| Plat No. | 12. | 13. | 33. | 34. | 54.* | 55.* | 75. | 76.* |
|---|---|---|---|---|---|---|---|---|
| Number canes ground | 60 | 65 | 20 | 19 | ........ | ........ | 16 | ...... |
| Per cent reaching Brix standard | 16.77 | 10.77 | 10.00 | 15.79 | ........ | ........ | 12.50 | ...... |
| Average sucrose, all analyses..p. ct. | 17.30 | 17.10 | 17.50 | 17.20 | ........ | ........ | 16.30 | ...... |
| Average purity, all analyses | 78.50 | 78.90 | 79.70 | 79.00 | ........ | ........ | 76.50 | ...... |
| Average nonsugars, all analyses, p. ct. | 3.80 | ........ | 3.80 | 3.90 | ........ | ........ | ........ | ...... |
| Average weight per cane.......lbs. | 1.38 | 1.12 | 1.50 | 1.39 | ........ | ........ | 1.03 | ...... |

* No stand secured.

**Table XXXVII.**—*Comparison of varieties, based on Table IV.*

[Per cent canes reaching Brix standard omitted as not comparable.]

| | Colman. | Links. | Collier. | Planter's Friend. |
|---|---|---|---|---|
| Average sucrose, all analyses ..................... per cent.. | 17.9 | 16.0 | 17.4 | 17.2 |
| Average purity, all analyses | 79.7 | 78.1 | 77.3 | 78.6 |
| Average non-sugars, all analyses ..................... per cent.. | 4.0 | 3.8 | 4.2 | 3.8 |
| Average weight per cane ..................... pounds.. | 1.66 | 1.10 | 1.05 | 1.27 |

In the preceding tables it will again be noted how evidently Colman cane excels the three other varieties with which it has chiefly competed during the past season.

It remains to be said, respecting these four varieties, that Colman is the only one which has shown no special tendency to develop supplemental panicles. As in all sorghums this tendency is exhibited as maturity advances, but with Colman it is not marked until a comparatively late stage, while perhaps Link ranks at the opposite extreme, developing many accessory panicles before the central seed top is nearly ripened.

## THE FIELD PLATS.

These plats comprised the four varieties, Colman, Link, Collier, and Planter, one plat of each in each series.

The first series, as in the selection plats, was best in point of stand and chemical record; the second series excelled in size of the canes produced, at least in their height and vigorous appearance, and the thin stand was caused by insect attacks. Each plat was a single row, about 425 feet from end to end.

In sampling, twenty consecutive canes were taken from each row, ten from an end and ten from the middle, and these average samples were drawn at regular weekly intervals.

The following tables, XXXVIII and XXXIX, contain the summary of the analytical work, and the tonnage data are collected in Table XL.

## TABLE XXXVIII.—*Summary of average sample analyses.*—FIRST SERIES.

### PLAT A—COLMAN.

| Serial No. | Date. | Days from planting. | Solids. | Sucrose. | Purity. | Glucose. | Non-sugars. | Non-sugar ratio. |
|---|---|---|---|---|---|---|---|---|
| | | | *Per cent.* | *Per cent.* | | *Per cent.* | *Per cent.* | |
| 7 | July 30 | 138 | 19.8 | 16.2 | 81.8 | 0.8 | 2.8 | 17.3 |
| 11 | Aug. 6 | 145 | 21.5 | 17.8 | 82.5 | 1.1 | 2.6 | 14.6 |
| 20 | Aug 13 | 152 | 21.2 | 16.8 | 79.2 | 0.6 | 3.8 | 22.6 |
| 31 | Aug. 20 | 159 | 22.1 | 18.1 | 81.9 | 0.5 | 3.5 | 19.3 |
| 45 | Aug. 27 | 166 | 21.8 | 17.2 | 78.9 | 0.7 | 3.9 | 22.7 |
| 57 | Sept. 3 | 173 | 21.3 | 16.5 | 77.5 | 0.6 | 4.2 | 25.5 |
| 69 | Sept. 10 | 180 | 21.0 | 16.6 | 79.0 | 0.6 | 3.8 | 22.9 |
| 81 | Sept. 17 | 187 | 20.0 | 15.7 | 78.5 | 0.6 | 3.7 | 23.6 |
| Average | | | 21.1 | 16.8 | 79.6 | 0.7 | 3.6 | 21.4 |
| Maximum | | | 22.1 | 18.1 | 82.5 | 1.1 | 4.2 | 23.6 |
| Minimum | | | 19.8 | 15.7 | 77.5 | 0.5 | 2.6 | 14.6 |

### PLAT C—LINK.

| Serial No. | Date. | Days from planting. | Solids. | Sucrose. | Purity. | Glucose. | Non-sugars. | Non-sugar ratio. |
|---|---|---|---|---|---|---|---|---|
| | | | *Per cent.* | *Per cent.* | | *Per cent.* | *Per cent.* | |
| 8 | July 30 | 138 | 18.6 | 15.1 | 81.2 | 0.9 | 2.6 | 17.2 |
| 12 | Aug. 6 | 145 | 20.6 | 16.4 | 79.6 | 0.9 | 3.3 | 20.1 |
| 21 | Aug. 13 | 152 | 20.1 | 16.4 | 81.6 | 0.6 | 3.1 | 18.9 |
| 32 | Aug. 20 | 159 | 19.9 | 16.7 | 83.9 | 0.5 | 2.7 | 16.2 |
| 47 | Aug. 27 | 166 | 19.8 | 15.9 | 80.3 | 0.6 | 3.3 | 20.8 |
| 59 | Sept. 3 | 173 | 19.1 | 15.3 | 80.1 | 0.5 | 3.3 | 21.6 |
| 71 | Sept. 10 | 180 | 17.4 | 14.0 | 80.5 | 0.6 | 2.8 | 20.6 |
| 83 | Sept. 17 | 187 | 17.1 | 13.5 | 78.9 | 0.6 | 3.0 | 22.2 |
| Average | | | 19.1 | 15.4 | 80.6 | 0.7 | 3.0 | 19.5 |
| Maximum | | | 20.6 | 16.7 | 83.9 | 0.9 | 3.3 | 22.2 |
| Minimum | | | 17.1 | 13.5 | 78.9 | 0.5 | 2.6 | 16.2 |

### PLAT E—COLLIER.

| Serial No. | Date. | Days from planting. | Solids. | Sucrose. | Purity. | Glucose. | Non-sugars. | Non-sugar ratio. |
|---|---|---|---|---|---|---|---|---|
| | | | *Per cent.* | *Per cent.* | | *Per cent.* | *Per cent.* | |
| 9 | July 30 | 138 | 19.7 | 16.8 | 85.3 | 0.6 | 2.3 | 13.7 |
| 13 | Aug. 6 | 145 | 20.7 | 16.2 | 78.3 | 0.9 | 3.6 | 22.2 |
| 22 | Aug. 13 | 152 | 20.8 | 16.5 | 79.3 | 0.6 | 3.7 | 22.4 |
| 33 | Aug. 20 | 159 | 21.4 | 17.3 | 80.8 | 0.4 | 3.7 | 21.4 |
| 49 | Aug. 27 | 166 | 19.9 | 16.2 | 81.4 | 0.6 | 3.1 | 19.1 |
| 61 | Sept. 3 | 173 | 19.9 | 15.4 | 77.4 | 0.6 | 3.9 | 25.3 |
| 73 | Sept. 10 | 180 | 18.6 | 14.7 | 79.0 | 0.7 | 3.2 | 21.8 |
| 85 | Sept. 17 | 187 | 18.1 | 13.7 | 75.7 | 1.1 | 3.3 | 24.1 |
| Average | | | 19.9 | 15.9 | 79.9 | 0.7 | 3.3 | 20.8 |
| Maximum | | | 21.4 | 17.3 | 85.3 | 1.1 | 3.9 | 25.3 |
| Minimum | | | 18.1 | 13.7 | 75.7 | 0.4 | 2.3 | 13.7 |

TABLE XXXVIII.—*Summary of average sample analyses.*—FIRST SERIES—Continued.

PLAT G—PLANTER.

| Serial No. | Date. | Days from planting. | Solids. | Sucrose. | Purity. | Glucose. | Non-sugars. | Non-sugar ratio. |
|---|---|---|---|---|---|---|---|---|
| | | | *Per cent.* | *Per cent.* | | *Per cent.* | *Per cent.* | |
| 10 | July 30 | 138 | 19.4 | 15.3 | 78.9 | 2.0 | 2.1 | **13.7** |
| 14 | Aug. 6 | 145 | 20.1 | 15.1 | 75.1 | 2.1 | 2.9 | **19.2** |
| 23 | Aug. 13 | 152 | 20.0 | 15.9 | 79.5 | 1.6 | 2.5 | **15.7** |
| 34 | Aug. 20 | 159 | 20.0 | 15.9 | 79.5 | 1.1 | 3.0 | **18.9** |
| 51 | Aug. 27 | 166 | 19.3 | 15.2 | 78.7 | 0.9 | 3.2 | **21.1** |
| 63 | Sept. 3 | 173 | 18.6 | 13.9 | 74.7 | 1.4 | 3.3 | **23.7** |
| 75 | Sept. 10 | 180 | 16.5 | 12.5 | 75.8 | 1.4 | 2.6 | **20.8** |
| 87 | Sept. 17 | 187 | 15.6 | 11.1 | 71.1 | 1.6 | 2.9 | **26.1** |
| Average | | | 18.7 | 14.4 | 77.0 | 1.5 | 2.8 | **19.4** |
| Maximum | | | 20.1 | 15.9 | 79.5 | 2.1 | 3.3 | **26.1** |
| Minimum | | | 15.6 | 11.1 | 71.1 | 0.9 | 2.1 | **13.7** |

TABLE XXXIX.—*Summary of average sample analyses.*—SECOND SERIES.

PLAT B—COLMAN.

| Serial No. | Date. | Days from planting. | Solids. | Sucrose. | Purity. | Glucose. | Non-sugars. | Non-sugar ratio. |
|---|---|---|---|---|---|---|---|---|
| | | | *Per cent.* | *Per cent.* | | *Per cent.* | *Per cent.* | |
| 41 | Aug. 22 | 111 | 18.6 | 14.8 | 79.6 | 1.1 | 2.7 | **18.2** |
| 46 | Aug. 27 | 116 | 19.1 | 15.3 | 80.1 | 0.8 | 3.0 | **19.6** |
| 58 | Sept. 3 | 123 | 21.3 | 16.6 | 77.9 | 0.9 | 3.8 | **22.9** |
| 70 | Sept. 10 | 130 | 20.0 | 15.9 | 79.5 | 0.8 | 3.3 | **20.8** |
| 82 | Sept. 17 | 137 | 21.5 | 16.9 | 78.6 | 0.7 | 3.9 | **23.1** |
| 89 | Sept. 24 | 144 | 21.9 | 17.6 | 80.4 | 0.5 | 3.8 | **21.6** |
| Average | | | 20.4 | 16.2 | 79.4 | 0.8 | 3.4 | **20.9** |
| Maximum | | | 21.9 | 17.6 | 80.4 | 1.1 | 3.9 | **23.1** |
| Minimum | | | 18.6 | 14.8 | 77.9 | 0.5 | 2.7 | **18.2** |

PLAT D—LINK.

| Serial No. | Date. | Days from planting. | Solids. | Sucrose. | Purity. | Glucose. | Non-sugars. | Non-sugar ratio. |
|---|---|---|---|---|---|---|---|---|
| | | | *Per cent.* | *Per cent.* | | *Per cent.* | *Per cent.* | |
| 42 | Aug. 22 | 111 | 20.5 | 15.2 | 74.1 | 1.0 | 4.3 | **28.3** |
| 48 | Aug. 27 | 116 | 20.9 | 15.5 | 74.2 | 1.9 | 3.5 | **22.6** |
| 60 | Sept. 3 | 123 | 20.4 | 15.9 | 77.9 | 1.9 | 2.6 | **16.3** |
| 72 | Sept. 10 | 130 | 19.9 | 16.4 | 82.4 | 0.9 | 2.6 | **15.9** |
| 84 | Sept. 17 | 137 | 18.8 | 14.5 | 77.1 | 1.9 | 2.4 | **16.6** |
| 90 | Sept. 24 | 144 | 18.7 | 14.2 | 75.9 | 1.7 | 2.6 | **18.3** |
| Average | | | 19.7 | 15.3 | 77.7 | 1.7 | 2.8 | **18.3** |
| Maximum | | | 20.9 | 16.4 | 82.4 | 1.6 | 4.3 | **28.3** |
| Minimum | | | 18.7 | 14.2 | 74.1 | 0.9 | 2.4 | **15.9** |

PLAT F—COLLIER.

| Serial No. | Date. | Days from planting. | Solids. | Sucrose. | Purity. | Glucose. | Non-sugars. | Non-sugar ratio. |
|---|---|---|---|---|---|---|---|---|
| | | | *Per cent.* | *Per cent.* | | *Per cent.* | *Per cent.* | |
| 43 | Aug. 22 | 111 | 20.7 | 16.7 | 80.7 | 0.6 | 3.4 | **20.4** |
| 50 | Aug. 27 | 116 | 21.0 | 16.9 | 80.5 | 0.9 | 3.2 | **18.9** |
| 62 | Sept. 3 | 123 | 21.8 | 17.4 | 79.8 | 0.6 | 3.8 | **21.8** |
| 74 | Sept. 10 | 130 | 20.5 | 16.6 | 81.0 | 0.6 | 3.3 | **19.9** |
| 86 | Sept. 17 | 137 | 19.4 | 15.3 | 78.9 | 0.7 | 3.4 | **22.2** |
| 91 | Sept. 24 | 144 | 19.5 | 14.6 | 74.9 | 1.4 | 3.5 | **23.9** |
| Average | | | 20.5 | 16.3 | 79.5 | .8 | 3.4 | **20.9** |
| Maximum | | | 21.8 | 17.4 | 81.0 | 1.4 | 3.8 | **23.9** |
| Minimum | | | 19.4 | 14.6 | 74.9 | 0.6 | 3.2 | **18.9** |

TABLE XXXIX.—*Summary of average sample analyses.*—SECOND SERIES—Continued.

PLAT H—PLANTER.

| Serial No. | Date. | Days from planting. | Solids. | Sucrose. | Purity. | Glucose. | Non-sugars. | Non-sugar ratio. |
|---|---|---|---|---|---|---|---|---|
| | | | *Per cent.* | *Per cent.* | | *Per cent.* | *Per cent.* | |
| 44 | Aug. 22 | 111 | 20.5 | 16.3 | 79.5 | 1.3 | 2.9 | 17.8 |
| 52 | Aug. 27 | 116 | 21.5 | 17.3 | 80.5 | 1.0 | 3.2 | 18.5 |
| 64 | Sept. 3 | 123 | 21.2 | 16.6 | 78.3 | 1.0 | 3.6 | 21.7 |
| 76 | Sept. 10 | 130 | 19.7 | 14.9 | 75.6 | 0.9 | 3.9 | 26.2 |
| 88 | Sept. 17 | 137 | 18.0 | 13.6 | 75.6 | 1.8 | 3.1 | 22.8 |
| 92 | Sept. 24 | 144 | 16.9 | 12.0 | 71.0 | 2.0 | 2.9 | 24.2 |
| Average | | | 19.6 | 15.1 | 77.0 | 1.3 | 3.2 | 21.2 |
| Maximum | | | 21.5 | 17.3 | 80.5 | 2.0 | 3.9 | 26.2 |
| Minimum | | | 16.9 | 12.0 | 71.0 | 0.9 | 2.9 | 17.8 |

TABLE XL.—*Summary of tonnage data.*

FIELD PLATS, FIRST SERIES.

| | Plat A (Colman). | Plat C (Link). | Plat E (Collier). | Plat G (Planter). |
|---|---|---|---|---|
| Length of plat ... feet | 425 | 426 | 426 | 427 |
| Total number canes produced | 1,401 | 1,285 | 1,262 | 1,271 |
| Average number canes per running foot | 3.3 | 3.0 | 3.0 | 3.0 |
| Total weight clean cane ... pounds | 928.2 | 699.0 | 718.1 | 687.6 |
| Average weight per cane ... do | 0.663 | 0.544 | 0.569 | 0.541 |
| Average weight clean cane per running foot ... do | 2.2 | 1.6 | 1.7 | 1.6 |
| Yield, clean cane per acre, based on 4-foot rows ... tons | 12,012 | 8,736 | 9,282 | 8,736 |

It will be seen that for forty-nine days Colman (Plat A), of the first series, furnished canes averaging nearly 17 per cent sucrose and nearly 80 per cent purity.

For thirty-three days in the second planting (Plat B) Colman held a very good record, and was yet advancing when the work ended. Collier (Plat F) ranks chemically with Colman in this series, but Link and Planter are both below standard, although comparatively good canes.

In Table XL the tonnage data are presented in a form not requiring explanation and the superiority of Colman is again shown.

Table XLI contains a summary of the experiment made with plats Nos. 68 and 73, of which the purpose was to study the effect, if any, produced by removing suckers or tillers. For this end, in each of these plats, a central division was made, marked by a stake, and from one-half of each row all tillers were carefully destroyed, leaving only seedling canes, while the other half was untouched.

Fifteen consecutive canes from each side of the stake were taken once a week from these two plats, and the analyses entered as from "desuckered" and "not desuckered" canes, respectively.

The canes were trashed and topped before weighing.

TABLE XLI.—*Comparison of desuckered with not desuckered halves of plats.*

### PLAT NO. 68.—LINK—DESUCKERED HALF OF PLAT.

| Serial No. | Date. | Average weight per cane. | Solids. | Sucrose. | Purity. | Glucose. | Non-sugars. |
|---|---|---|---|---|---|---|---|
| | | *Pounds.* | *Per cent.* | *Per cent.* | | *Per cent.* | *Per cent.* |
| 3 | July 29 | .......... | 19.5 | 16.2 | 83.1 | 0.6 | 2.7 |
| 15 | Aug. 6 | .......... | 20.1 | 16.6 | 82.6 | 0.5 | 3.0 |
| 25 | Aug. 13 | .......... | 19.1 | 15.5 | 81.2 | 0.7 | 2.9 |
| 38 | Aug. 20 | .......... | 18.9 | 14.7 | 77.8 | 1.4 | 2.6 |
| 53 | Aug. 27 | .......... | 19.2 | 13.1 | 68.2 | 2.9 | 3.2 |
| 65 | Sept. 3 | .......... | 19.1 | 13.7 | 71.7 | 1.9 | 3.5 |
| 77 | Sept. 10 | .......... | 17.5 | 13.3 | 76.0 | 0.5 | 3.7 |
| Average ... | | 0.57 | 19.1 | 14.7 | 76.9 | 1.2 | 3.2 |
| Maximum . | | 0.83 | 20.1 | 16.6 | 83.1 | 2.9 | 3.7 |
| Minimum .. | | 0.43 | 17.5 | 13.1 | 68.2 | 0.5 | 2.6 |

### PLAT NO. 68.—LINK—HALF OF PLAT NOT DESUCKERED.

| Serial No. | Date. | Average weight per cane. | Solids. | Sucrose. | Purity. | Glucose. | Non-sugars. |
|---|---|---|---|---|---|---|---|
| | | *Pounds.* | *Per cent.* | *Per cent.* | | *Per cent.* | *Per cent.* |
| 4 | July 29 | .......... | 18.8 | 15.2 | 80.9 | 0.8 | 2.8 |
| 16 | Aug. 6 | .......... | 20.8 | 16.3 | 78.4 | 1.8 | 2.7 |
| 26 | Aug. 13 | .......... | 19.9 | 15.0 | 75.4 | 0.8 | 4.1 |
| 37 | Aug. 20 | .......... | 19.1 | 15.6 | 81.7 | 0.8 | 2.7 |
| 54 | Aug. 27 | .......... | 18.8 | 14.6 | 77.7 | 1.3 | 2.9 |
| 66 | Sept. 3 | .......... | 18.9 | 13.7 | 72.5 | 1.9 | 3.3 |
| 78 | Sept. 10 | .......... | 17.5 | 12.8 | 73.1 | 0.5 | 4.2 |
| Average .. | | 0.55 | 19.1 | 14.7 | 76.9 | 1.1 | 3.3 |
| Maximum . | | 0.63 | 20.8 | 16.3 | 81.7 | 1.9 | 4.2 |
| Minimum .. | | 0.47 | 17.5 | 12.8 | 72.5 | 0.5 | 2.7 |

### PLAT NO. 73.—PLANTER—DESUCKERED HALF OF PLAT.

| Serial No. | Date. | Average weight per cane. | Solids. | Sucrose. | Purity. | Glucose. | Non-sugars. |
|---|---|---|---|---|---|---|---|
| | | *Pounds.* | *Per cent.* | *Per cent.* | | *Per cent.* | *Per cent.* |
| 5 | July 29 | .......... | 18.9 | 14.4 | 76.2 | 1.6 | 2.9 |
| 17 | Aug. 6 | .......... | 19.7 | 15.5 | 78.7 | 1.9 | 2.3 |
| 27 | Aug. 13 | .......... | 20.0 | 15.4 | 77.0 | 1.3 | 3.3 |
| 40 | Aug. 20 | .......... | 20.0 | 12.3 | 61.5 | 4.5 | 3.2 |
| 55 | Aug. 27 | .......... | 19.9 | 13.2 | 66.3 | 3.6 | 3.1 |
| 67 | Sept. 3 | .......... | 19.6 | 13.9 | 70.9 | 2.2 | 3.5 |
| 79 | Sept. 10 | .......... | 17.8 | 12.0 | 67.4 | 1.0 | 4.8 |
| Average ... | | 0.61 | 19.4 | 13.8 | 71.1 | 2.3 | 3.3 |
| Maximum . | | 0.77 | 20.0 | 15.5 | 78.7 | 4.5 | 4.8 |
| Minimum .. | | 0.43 | 17.8 | 12.0 | 61.5 | 1.0 | 2.3 |

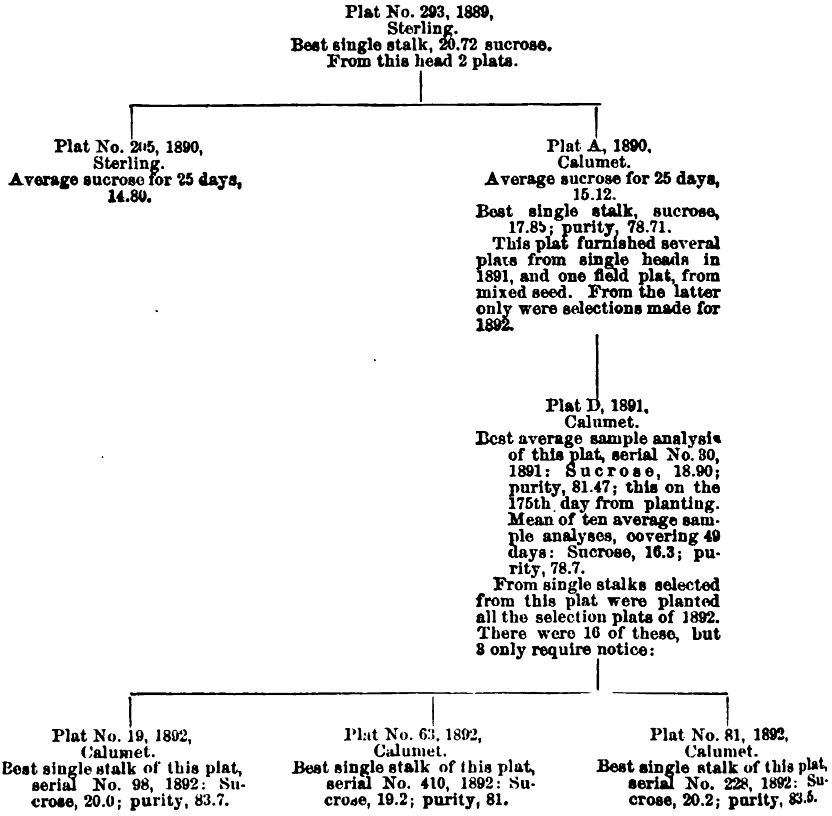
### PLAT NO. 73.—PLANTER—HALF OF PLAT NOT DESUCKERED.

| Serial No. | Date. | Average weight per cane. | Solids. | Sucrose. | Purity. | Glucose. | Non-sugars. |
|---|---|---|---|---|---|---|---|
| | | *Pounds.* | *Per cent.* | *Per cent.* | | *Per cent.* | *Per cent.* |
| 6 | July 29 | .......... | 17.8 | 13.9 | 78.1 | 1.7 | 2.2 |
| 18 | Aug. 6 | .......... | 20.3 | 15.3 | 75.4 | 2.5 | 2.5 |
| 28 | Aug. 13 | .......... | 19.8 | 15.9 | 80.3 | 1.7 | 2.2 |
| 39 | Aug. 20 | .......... | 20.1 | 15.9 | 79.1 | 1.8 | 2.4 |
| 56 | Aug. 27 | .......... | 21.2 | 12.2 | 57.5 | 5.5 | 3.5 |
| 68 | Sept. 3 | .......... | 19.9 | 13.6 | 68.3 | 2.5 | 3.8 |
| 80 | Sept. 10 | .......... | 16.7 | 12.8 | 76.6 | 0.9 | 3.0 |
| Average ... | | 0.51 | 19.4 | 14.2 | 73.2 | 2.4 | 2.8 |
| Maximum . | | 0.63 | 21.2 | 15.9 | 80.3 | 5.5 | 3.8 |
| Minimum .. | | 0.30 | 16.7 | 12.2 | 57.5 | 0.9 | 2.2 |

The figures show a slightly greater average weight in the desuckered canes, which was to be expected. In the chemical analysis of the canes from the desuckered and not desuckered halves of the plats, there is practically no difference whatever, demonstrating that in the case of the plats experimented with the presence or absence of the few tillers did not at all affect the value of the canes.

Having recommended Colman as seemingly an appropriate cane for future experiments here, and having selected seed of that variety for the purpose, the pedigree of the stock grown here may be recorded.

The original single seed head from which the variety sprung was a cross of Amber and Kansas Orange, selected at Sterling in 1887. From this seed head was grown Sterling Plat No. 153, of 1888. From this plat the best single stalk selected (serial No. 652, 1888), gave upon analysis, sucrose, 17.18; purity, 76.35; glucose, 0.58: nonsugars, 4.74. This seed head in its turn furnished Sterling Plat No. 293, of 1889, and its best single cane gave sucrose of 20.72 per cent. A part of this seed head was received at Calumet, and was planted as Plat "A," 1890, while the remainder was retained at Sterling as Plat No. 205 of that year. Thus, in 1890, two plats were grown from the one head, one in Louisiana and one in Kansas, respectively:



Plat No. 293, 1889,
Sterling.
Best single stalk, 20.72 sucrose.
From this head 2 plats.

Plat No. 205, 1890,
Sterling.
Average sucrose for 25 days,
14.80.

Plat A, 1890,
Calumet.
Average sucrose for 25 days,
15.12.
Best single stalk, sucrose, 17.85; purity, 78.71.
This plat furnished several plats from single heads in 1891, and one field plat, from mixed seed. From the latter only were selections made for 1892.

Plat D, 1891,
Calumet.
Best average sample analysis of this plat, serial No. 30, 1891: Sucrose, 18.90; purity, 81.47; this on the 175th day from planting. Mean of ten average sample analyses, covering 49 days: Sucrose, 16.3; purity, 78.7.
From single stalks selected from this plat were planted all the selection plats of 1892. There were 16 of these, but 3 only require notice:

Plat No. 19, 1892,
Calumet.
Best single stalk of this plat, serial No. 98, 1892: Sucrose, 20.0; purity, 83.7.

Plat No. 63, 1892,
Calumet.
Best single stalk of this plat, serial No. 410, 1892: Sucrose, 19.2; purity, 81.

Plat No. 81, 1892,
Calumet.
Best single stalk of this plat, serial No. 228, 1892: Sucrose, 20.2; purity, 83.5.

At the very beginning the regular quality of the seed in the parent (Sterling) head was shown by the close agreement of the analyses in the Sterling and Calumet plats of 1890. Plat "D," of 1891, was notable for the little variation and high record of the canes grown, and in 1892, in plats 19 and 81 and to but slightly less degree in 63, this uniformity of character was also apparent.

An earlier report discussed some of the difficulties encountered in preserving sorghum seed in this climate from insect damage after packing away, and mention was made of the failure of pyrethrum powder or treatment with ether to give effective protection. Since then (1890) a method has been tried which possesses reasonable efficiency and which has kept the seed quite satisfactorily. This is by mixture of the seed with dry, powdered, carbolated lime. The lime is prepared by mixing a little fresh, dry air-slaked lime with strong phenol (say 20 grams of lime and 10 c. c. phenol), allowing this to cake and harden, which it rapidly does, then powdering the mass thoroughly and stirring well with about a half pound of the dry lime. Enough of this powder is shaken with the seed to give a white coating and leave a small quantity loose in the package. The phenol does not sensibly affect the seed.

Dr. W. C. Stubbs writes that he finds carbon disulphide a good agent for the same purpose, dropping a little into the bottle of seed and corking tightly. But the lime, if care be taken to have it dry, is an absorbent of moisture, and this is an advantage where seed are not perfectly dried before packing.

Mr. O. D. Berwick, who assisted at this work in 1891, was given charge of the analytical work in 1892, and is entitled to credit therefor.

## COÖPERATION WITH STATE EXPERIMENT STATIONS.

Samples of high-grade sorghum seed were sent to the stations mentioned below, with a letter requesting coöperative work in determining the character of the crop in different localities. The stations of the more northern States were omitted from the list because it was not thought possible to secure any satisfactory results in such localities.

At the beginning of December no reports had been received from the State Stations, and Mr. A. W. Harris, Director of the Office of Experiment Stations, was requested to communicate with the directors of the several stations for the purpose of expediting their reports. Only a few responses have been received. Evidently there is almost complete apathy felt on the part of the stations for this work, and its continuance is not promising of success.

Following is a list of the directors and stations to which seeds were sent:

R. L. Bennit, Arkansas.
W. L. Broun, Alabama.
F. A. Gulley, Arizona.
E. W. Hilgard, California.
W. J. Quick, Colorado.
S. W. Johnson, Connecticut.
A. T. Neale, Delaware.
J. P. De Pass, Florida.
R. J. Redding, Georgia.
James Wilson, Iowa.
C. S. Plumb, Indiana.
G. E. Morrow, Illinois.
M. A. Scovell, Kentucky.
W. C. Stubbs, Louisiana.
S. M. Tracy, Mississippi.
E. D. Porter, Missouri.
H. E. Alvord, Maryland.
H. B. Battle, North Carolina.
S. A. Jones, Nevada.
Jas. Wilson, New Jersey.
H. Hadley, New Mexico.
P. Collier, New York.
C. E. Thorne, Ohio.
B. L. Arnold, Oregon.
J. C. Neal, Oklahoma.
H. P. Armsby, Pennsylvania.
H. A. Strode, South Carolina.
G. W. Curtis, Texas.
F. L. Scribner, Tennessee.
J. W. Sanborn, Utah.
J. M. McBride, Virginia.
J. A. Myers, West Virginia.

## REPORTS FROM STATIONS.

The following reports of results of experiments in the cultivation of sorghum were received by Mr. A. W. Harris, Director of the Office of Experiment Stations:

Agricultural Experiment Station, University of Illinois: The land used had been in small fruit for several years and was fall plowed. June 7, the land was harrowed and marked 3 feet 8 inches both ways and the seed dropped six kernels per hill and covered with a hoe. The plats were each nine hills east and west by six hills north and south, and numbered, as shown in the diagram. There was an extra row on the south, west, north, and six extra rows on the east. Plats 10 to 15, inclusive, were from analyzed stalks.

| | | | | |
|---|---|---|---|---|
| 11 | 12 | 13 | 14 | 15 |
| 6 | 7 | 8 | 9 | 10 |
| 1 | 2 | 3 | 4 | 5 |

June 25, cultivated east and west with the Superior cultivator. July 8 and July 15, the same. July 18, removed weeds with hoe. June 16 to 25 tested seed in Geneva apparatus. October 10, ascertained total weight of product from each plat, which is given in the following table:

| No. plat. | Name of variety. | Germinating in apparatus. | Total product per plat. | Seed head, No. | Solids in juice.* | Sugar in juice.* | Purity.* | Solids in juice. | Sugar in juice. | Purity. |
|---|---|---|---|---|---|---|---|---|---|---|
| | | *Per cent.* | *Pounds.* | | *Per ct.* | *Per ct.* | | *Per ct.* | *Per ct.* | |
| 1 | Colman | 86 | 541 | | | | | 17.25 | 11.51 | 66.72 |
| 2 | Colman (red) | 35 | 413 | | | | | 18.00 | 13.50 | 75.00 |
| 3 | No. 91 | 91 | 505 | | | | | 16.50 | 10.76 | 65.21 |
| 4 | Collier | 93 | 372 | | | | | 20.00 | 13.68 | 68.40 |
| 5 | Folger | 89 | 315 | | | | | 17.00 | 10.76 | 63.29 |
| 6 | Link | 60 | 505 | | | | | 17.75 | 12.40 | 69.86 |
| 7 | McLean | 96 | 548 | | | | | 17.75 | 12.66 | 71.32 |
| 8 | African | 68 | 548 | | | | | 17.25 | 12.13 | 70.32 |
| 9 | Planter | 84 | 605 | | | | | 19.00 | 12.32 | 64.81 |
| 10 | Folger | | 355 | 7199 | 19.33 | 15.15 | 78.25 | 18.00 | 12.79 | 71.05 |
| 11 | Orange | | 705 | 8784 | 21.60 | 16.72 | 77.28 | 19.00 | 13.94 | 77.42 |
| 12 | Amber | | 501 | 3846 | 19.00 | 14.65 | 76.40 | 17.50 | 12.14 | 69.37 |
| 13 | Link (lot 59) | | 420* | 12016 | 21.13 | 16.20 | 76.77 | 18.50 | 13.28 | 71.78 |
| 14 | Link | | 657 | 11495 | 20.36 | 15.50 | 75.92 | 16.50 | 11.03 | 66.85 |
| 15 | Orange and Amber Cross | | 470 | 8531 | 19.8 | 15.04 | 75.76 | 19.00 | 12.62 | 66.42 |

* The analyses in these three columns were of canes on which the seed grew, which was furnished this station by the Department of Agriculture from pedigreed seed.

New Mexico College of Agriculture: A comparative test of sorghums for the amount of saccharine matter contained was made this season with ten varieties. The seed was planted April 28.

Five canes of each variety were cut October 6, stripped of leaves, and weighed. All attained about the same stage of maturity, and had ripened their seeds, except Collier, which was not quite ripe. Owing to the failure of the water supply early in the season but two irrigations were given. There was no marked difference in their ability to withstand the drought.

The appended table gives a list of varieties and weight of each stripping, together with the chemical analysis made by the chemist.

*Table showing experiments with sorghums.*

| Name. | Weight of stripped cane. | | Amount of expressed juice. | Specific gravity. | Sucrose in juice. |
|---|---|---|---|---|---|
| | *Lbs.* | *ozs.* | *Ounces.* | | *Per cent.* |
| Collier | 4 | 3 | 16 | 1.141 | 21.9 |
| Mexican | 5 | 8 | 28 | 1.103 | 1.5 |
| Folger | 5 | 2 | 20 | 1.120 | 9.6 |
| Colman | 5 | 10 | 31 | 1.116 | 11.9 |
| Planter | 7 | 11 | 35 | 1.104 | 11.0 |
| Colman (red) | 3 | 10 | 18 | 1.113 | 13.7 |
| African | 5 | 6 | 22 | 1.118 | 8.0 |
| Variety 91 | 6 | 8 | 30 | 1.112 | 12.6 |
| Link | 3 | 11 | 16 | 1.128 | 11.4 |
| McLean | 3 | 15 | 13 | | 16.9 |

B. W. McDowell, director Nevada Agricultural Experiment Station: I send you names of varieties, date of planting, coming up, cultivation, irrigation, weights of cane and seed, analysis by Prof. Wilson, station chemist. For development in the field Folger's Early was much in advance of the other varieties. It began heading August 18. McLean's did not begin heading till August 23. Variety 91 still later. The others did not head. The sorghum was planted on land that was raising alfalfa in 1890, broken and sown to wheat in 1891. We had quite a sharp frost early in June.

| Name of sorghum. | Weight of cane and seed. | | Remarks. |
|---|---|---|---|
| | *Pounds.* | *Ounces.* | |
| African | 2,930½ | 8 | Did not head. |
| Folger | 338 | 9 | Ripened. |
| Link | 233 | 10 | Did not head. |
| Colman | 301 | 14 | Do. |
| Collier | 260 | 9 | Do. |
| Variety 91 | 365 | 3 | 10 heads ripe. |
| McLean | 338 | 5 | About 1 head in 10 ripened. |
| Planter | 222 | 4 | Did not head. |
| Colman (red) | 341 | 14 | Do. |

Nine varieties sorghum seed from United States Department of Agriculture were drilled May 24, 1892, two rows each, each row 132 feet long. Came up June 2. Cultivated June 16, July 9, 21, and 28. Hoed June 21, July 21. Irrigated June 25, July 3, 11, 26, August 3, 10, 19, 27, September 8. For development in the field, Folger was much in advance of the other varieties.

*Height of cane September 17, 1892.*

| | Inches. |
|---|---|
| African | 52 |
| Folger | 102 |
| Link | 55 |
| Colman | 80 |
| Colman (red) | 55 |
| Collier | 91 |
| Variety 91 | 96 |
| McLean | 66-114 |
| Planter | 48 |

The measurements given are for the longest canes.

| Variety. | Planted. | Harvested. | Sugar in juice. | Solids in juice. | Purity. |
|---|---|---|---|---|---|
| | | | *Per cent.* | *Per cent.* | |
| McLean | May 24, 1892 | Sept. 16, 1892 | 8.00 | 15.20 | 52.64 |
| Folger | do | do | 8.90 | 16.20 | 54.94 |
| Planter | do | Oct. 10, 1892 | 4.50 | 14.00 | 32.05 |
| McLean | do | do | 9.00 | 16.20 | 55.55 |
| Colman (red) | do | do | 9.50 | 13.20 | 71.96 |
| No. 91 | do | do | 8.10 | 19.40 | 41.75 |
| Folger | do | do | 11.10 | 21.60 | 51.38 |
| African | do | do | 2.00 | 14.60 | 13.70 |
| Folger (frosted) | do | Oct. 12, 1892 | 10.00 | 18.00 | 55.55 |
| McLean (frosted) | do | do | 12.80 | 19.20 | 66.66 |
| Colman | do | Oct. 10 1892 | 12.00 | 23.40 | 51.30 |
| No. 91 | do | Oct. 12, 1892 | 8.50 | 17.00 | 50.00 |
| Link | do | Oct. 10, 1892 | 4.30 | 14.80 | 29.06 |
| Folger (frosted) | do | Oct. 12, 1892 | 10.00 | 18.20 | 54.94 |

The above results are extremely poor and remind one very emphatically of the analyses of sorghum obtained before any attempt at improvement was made: The explanation of the poor results has been received from the officers of the station and will be found in the field notes preceding the table. It is evident from these notes that the climate of Nevada is not suited to the growth of sorghum.

R. L. Bennett, director Arkansas Agricultural Experiment Station: The letter accompanying the seed made no mention as to the special purpose of the trial or that the results were desired by the chemical department at Washington, and as this station had suspended the sorghum work for the present, to do other work more pressing, the seed sent were not planted. I regret that I did not know the chemical department specially desired the work.

A. C. Magruder, Oklahoma: The sorghums were grown on the farm, but owing to the great amount of work incident to our getting a late start (our station was only organized December, 1891) prevented the carrying out of the test properly. Results extend only so far as yield in pounds per acre of stalk and seeds and are here inaccurate, as the work was necessarily left to green hands. I therefore prefer to retain the data I have rather than send in what I can not vouch for. You will find me willing to undertake for you any work I can, as soon as I can get competent assistance or have time to personally look after the work.

D. O. Nourse, Virginia Agricultural Experiment Station: As we had undertaken all the work we were able to complete before the sorghum seed arrived, no tests were made.

H. P. Armsby, State College, Center County, Pa.: In response to yours of December 1, relative to seed of eight varieties of sorghum sent to this station for trial, I beg to say that work with sorghum is, to a considerable extent, foreign to the lines of work pursued by us, and that we thought it wise not to undertake it, since it was doubtful whether we could carry it through in a satisfactory manner.

Jas. P. De Pass, Lake City, Fla.: The sorghum seed sent by you last spring did not come up.

E. H. Jenkins, director Connecticut Agricultural Experiment Stations: Referring to your letter of November 30, "We have not had the facilities for testing the sorghum seeds which were sent to us. In general we are only able to test the seeds of forage grasses and occasionally of forest trees."

A. J. Bondurant, experiment station of the Agricultural and Mechanical College, Auburn, Ala.: In reply to your favor of recent date asking results of experiments of sorghum seed sent us for trial by your department, I beg leave to state that our line of experiments for the present season being so extensive, and the sorghum experiment having heretofore been fully made, and a bulletin issued thereon, we did not deem it necessary to repeat this experiment.

Prof. M. B. Hardin, chemist, Clemson Agricultural College, South Carolina Experiment Station:

| Variety. | Weight of cane per acre. | Pounds of cane to gallon of sirup. | Gallons per acre. |
|---|---|---|---|
| African | 13,475 | 149.73 | 90.0 |
| Colman | 13,437.5 | 97.72 | 137.5 |
| Colman (red) | 11,937 | 136.42 | 87.5 |
| Collier | 11,985 | 78.33 | 149.8 |
| Folger | 13,378 | 111.68 | 122.1 |
| Link | 8,989 | 93.68 | 99.9 |
| McLean | 13,053 | 114.16 | 116.5 |
| Planter | 9,396 | 112.75 | 83.2 |
| No. 91 | 12,312.5 | 92.03 | 133.1 |
| Gray Eagle | 17,172.7 | 105.55 | 145.4 |
| Orange | 14,522.7 | 93.97 | 154.5 |

*Analyses of juices of varieties of sorghum.*

| Variety. | Total solids. | Specific gravity 17.5° C. | Solids, not sugar. | Cane sugar. | Reducing sugars (glucose). |
|---|---|---|---|---|---|
| | *Per ct.* | | *Per cent.* | *Per cent.* | *Per cent.* |
| African * | 16.07 | 1.0660 | 3.90 | 8.00 | 4.17 |
| McLean * | 16.59 | 1.0682 | 7.09 | 4.40 | 5.10 |
| Planter * | 17.07 | 1.0704 | 7.07 | 2.81 | 7.19 |
| Colman * | 15.97 | 1.0656 | 4.64 | 5.63 | 5.70 |
| Folger * | 17.43 | 1.0717 | 3.26 | 6.62 | 7.55 |
| Variety 91 * | 17.59 | 1.0726 | 4.04 | 9.30 | 4.25 |
| Gray Eagle | 16.39 | 1.0674 | 4.91 | 6.18 | 5.30 |
| Orange | 16.39 | 1.0674 | 3.71 | 5.92 | 6.76 |
| Colman (red) * | 17.87 | 1.0739 | 5.38 | 8.01 | 4.48 |
| Link | 16.24 | 1.0665 | 5.02 | 6.90 | 4.32 |
| Collier * | 18.71 | 1.0775 | 10.63 | 4.20 | 3.87 |

* From U. S. Department of Agriculture.

J. W. Sanborn, director Utah Experiment Station: The sorghum seed which was sent to us last spring was taken charge of by Mr. Mills, the farm superintendent. He reports that the varieties did very much better than any that we have had before, but is unable to give more specific data. I gave no special attention to them, but have observed them frequently, yet am unable to say definitely as to the results, except that the Amber proved quite successful.

R. J. Redding, director Georgia Experiment Station: In reply to yours of 30th ultimo I beg to say that a portion of each of the varieties of seeds of sorghum was planted alongside other varieties previously in cultivation, simply as a test of the comparative value of each as forage producers. We do not make sirup (or sugar) at this station, and therefore are not prepared to test the different varieties for sugar. Mr. Speth did not observe any special merit in either of the varieties sent as forage producers in comparison with other varieties. I am aware that this is a rather unsatisfactory report, but it is the best that I can do.

Robert H. Miller, director Maryland Agricultural Experiment Station: Your favor of December 1 is at hand. There were no experiments with sorghum made at this station the past season.

## THE SORGHUM CULTURE EXPERIMENT STATION, STERLING, KANS.

Full details of the extensive experiments made at this station are given in the report of the assistant in charge, Mr. A. A. Denton, which follows:

In April, 1892, 175 acres of land were leased for the experimental culture work. It was difficult at that season to secure sufficient land on any terms, and land was leased wherever it could be had, with little choice in location or in quality of soil. A part of the land was sand, a part was heavy black land, a part was superior, and a part had been planted in cane for five years preceding.

Cane was planted on fourteen farms in different localities and at considerable distances. The plowing was from 4 to 5 inches deep. One harrowing, and on hard lands two harrowings, were given. The planting was begun April 8 and ended June 30, being done at intervals during a period of eighty-three days. Two hundred and eighty-seven small lots were planted, most of them with seeds from a selected cane of greatly superior quality. Some of the small lots were planted with seeds from several selected canes, and some of these lots were planted in canes of new varieties, or with seeds from unanalyzed canes of unusual size. One hundred and nine larger lots were also planted with seeds from many selected canes mixed together. It requires the seeds from about forty canes to plant 1 acre, though there are considerable differences in varieties in this respect. The small lots were planted by hand, while the larger lots were planted by machine.

As nearly as could be done, 2 pounds of seed was planted on 1 acre. On account of accidents to the crop, some replanting was necessary. Owing to dry weather at planting time, the lots which were planted by hand came up unevenly and irregularly. As in previous years, the lots planted by machine were superior. All of the larger lots were thinned; that is, superfluous plants were cut out with a hoe, giving each plant sufficient space for full development. As soon as the rows of cane could be plainly seen, the entire crop was rolled. Four cultivations were given. A part of the crop was cultivated with the large shovels ordinarily used on 2-horse cultivators in corn cultivation. A part was cultivated with long and narrow shovels, known as "bull tongues," these shovels often running deeper than the original plowing. A part was cultivated with spring-tooth cultivators, having eight small shovels suited to shallow cultivation, and a part of the crop was cultivated a fifth time, after the canes were in full blossom, with one-horse cultivators having five small shovels set shallow, and going but once in each space between two rows of cane. The cultivation by horse power was done better than in any previous year.

Less use of the hoe was necessary. At no time did weeds dispute ownership of the land with the cane.

Here, as elsewhere in this part of the State, the spring was cool and dry and growth was slow. The heat and the rainfall of June and July induced rapid and rank growth of cane. Dry weather in August and September checked the ripening of the canes. As compared with former years, the canes reached maximum per centages of sugar and their highest purities later. Early-maturing varieties, ripening in the extreme dry weather of August and September, showed fair percentages of sugar, with low purities, until the drouth ended. The same was true of the same varieties at the same season last year.

The tonnage, or the yield of cane was larger than in 1888, 1889, 1890, or 1891. It was approached only by that of 1889. In nearly all the varieties the quality of the juice was superior to that in former years. Whether the cause of the evident improvement is to be looked for in acclimation of the varieties, or in favorable seasons, or in selection of seed, the fact of increased tonnage of cane and of superior quality of juice is shown year by year since 1888.

The scattered nature of the agricultural work greatly increased the expense, but it had decided advantages. The analyses of the varieties, grown as they were in many localities, on very different soils, and from both early and late plantings, may be taken as general analyses of the same varieties which could have been grown on many thousands of acres included in all the localities where cane was grown by the station. It is safer to deduce averages from wide territory, and from many plantings in different soils, under dissimilar conditions, as is shown by the fact that the crops of a State vary less from year to year than the crops of a county, and much less than the crops of a single farm. Planting in different localities, at different times also gives a degree of security from merely local accidents. This season the cane in one field was injured by drifting sand, in another by a destructive hailstorm, and in another, which was passed by local rains, by drouth, while other fields escaped these injuries. Owing to this system of repeated plantings in different localities but few of the selections grown at this station in the past five years have been lost by the accidents of the seasons.

The analyses show that the earlier plantings required a greater period in which to reach maturity. They also show that the last plantings, in most cases, failed to fully mature, although the close of the season was as favorable as usual. With our present knowledge we are not able to foretell the character of the coming seasons, or to know whether the early or the late plantings will prosper most. It is safer to plant a part early, a part late, and the greater part at neither extreme.

But few new varieties were planted this season. The search for superior hybrids, which has given encouraging results in previous years was entirely discontinued. Many of the varieties which had been grown at this station in 1888, 1889, 1890, and 1891 were discarded.

The main object of this season's work has been to reduce the number of varieties by selecting a few superior varieties. It appears necessary that the varieties of sorghum should be given careful inspection and rigid selection. The number of varieties is very great, it is rapidly increasing by importation from foreign countries, and by hybridization. The great number of varieties increases the expense of experimental cultivation. It causes confusion in general cultivation. It appears that but three varieties, one ripening early, one medium, and one late, are necessary to secure a succession of fresh canes during the season of sugar manufacture.

In making final selection of varieties there are many points to be considered. A final selection implies the balancing of the good points of one variety with those of another. No variety has yet been found which includes all desirable qualities. A variety may have no special claim to superiority, but it may be more capable of improvement than other varieties. For instance, in 1888, the Collier variety, as compared with other varieties, was not remarkable in any way, but it has steadily improved, year by year, until it now stands near the head of the list of hundreds of varieties which have been grown at this station. As much labor has been expended upon some other varieties without corresponding improvement. While it is perhaps true that any variety of sorghum may be improved by patient and skillful selection of seed, it is also true that some varieties may be more quickly and surely improved.

The work of improving the varieties of sorghum should begin after the final selection of varieties. All the work of this station up to this time is regarded as merely preliminary to the final selection of a few varieties, which are not only superior, but which have shown capacity for improvement.

The work this season has turned mainly upon this point.

From the great number of varieties which had been grown at this station fifty varieties were selected for planting this season, special attention was given to sixteen varieties which had given best results in previous years. These sixteen varieties were planted in a large box filled with thoroughly mixed soil. They were watered alike and were grown under as similar conditions as possible, so that size, weight, quality of juice, time of maturing, relatively to each other, might be determined. The same sixteen varieties were again planted at the same time side by side, two rows of each variety, 40 rods long, so that their relative qualities in field culture might be determined. The same sixteeen varieties were again planted in each one of the fourteen farms occupied by the station, alternating the lots so that each variety shared as equally as possible the advantages and the disadvantages of the soil and the inevitable variations in the conditions of these plantings. By these frequent and varied plantings it seems that any accidental variation or error is not unduly multiplied in reducing the results to the generally accepted unit of yield per acre.

In reviewing the fieldwork of the present season it appears that fall plowing is a decided advantage when the ensuing spring is dry. But some loose and sandy soils are not suited to fall plowing.

In four of the five years since 1888, hand planting has given a more uneven and irregular stand of cane than machine planting. There seems no other way of planting small lots with the seeds of a single cane. It is obvious that uniformity of type of time of maturing, and of quality of juice may be much sooner obtained by planting the seeds from single selected canes in separate lots and by continuing this separate planting for a term of years, but it may be advisable hereafter to plant more large lots with mixed selected seeds and to plant fewer small lots.

Rolling as soon as the cane rows can be plainly seen makes it possible to cultivate closer to the young plants without covering them. But rolling should only be done when the soil is not wet. Where cane is planted in drill the art of keeping the row free from weeds without the use of the hoe should be carefully studied. The first cultivations decide the possession of the row.

Preference is given to the use of small shovels set to run shallow. With such cultivators the cultivation can be done closer to the row, with slight hilling of the row, and can be done later without injury to the canes, but with such cultivators it is necessary to keep ahead of weeds, for small shovels are not efficient where weeds are large.

In this soil cultivation seems to be advantageous whenever the soil becomes crusted or baked, no matter how small or large or free from weeds the crop may be. A dozen lots were selected to test this; one-half the rows of each lot were cultivated after the canes were in full blossom, using one-horse cultivators and going once in each row. The rows receiving the extra cultivation were fresher and suffered less from drought than the other rows.

Thinning or cutting out superfluous plants after the first cultivations, and before the plants become large, seems to give larger and better canes. The thinned canes endure drought better, the stand is more uniform and even. All the work which has been done at this station seems to show that while rank and excessive growth. as on rich soil ; in wet seasons, produces inferior juice, yet well-developed canes, fully ripened, give the maximum percentages of sugar. This, perhaps, explains the well-known fact that samples taken from loads of cane usually test higher than the entire load. In taking the samples the overgrown and the undersized canes are not taken, but the well-developed canes are taken.

In making selections of seed at this station, undersized canes are always rejected, the object being to breed to size of cane as well as to quality of juice.

Four varieties have been selected, and are recommended for general cultivation. They are Folger, Collier, McLean, and Colman.

Folger is the best early maturing variety. It undoubtedly originated in a cross of Amber and Link, as reversions may be found in its canes to both types, but the canes are quite uniform. Though it blossoms a full week later than Amber and apparently ripens later than that variety, yet it appears to have as high a percentage of sugar at one hundred days from planting as the Amber. It gives larger canes than Amber, the canes remain good much longer than those of Amber, which frequently deteriorate rapidly. An extensive search for new varieties which ripen early as Amber has given no better variety than Folger. This year, and also last year, both Folger and Amber ripened in a period of drought and had low purities until the drought ended. It is quite probable that this would have been true of any other varieties which ripened at the same time. By referring to the general analyses of Folger in 1888, it will be seen that this variety has made remarkable improvement in the five years in which selections of seed have been made from its canes. Many selections of seed were made last season, and also this year from its first ripening canes. It is believed it can be induced to ripen still earlier without loss of size, by selecting seed from well-developed and vigorous early maturing canes. This variety produced very fine sirup, all of which crystallized, although the canes were worked before the seed was fully formed.

The Collier variety is recommended as the best variety for Northern States. It has abundant foliage; although the canes are quite slender, yet it has always stood up well. It has very high percentages of sugar, with low glucose and fair purity. It ripens before Orange. Planted June 15, it matured well. Planted June 29, it failed to mature fully. By referring to the analyses of this variety which were made in 1888, it is seen that it has made constant improvement. It produces very fine sirup, but it seems difficult, with this variety, to make sirup which will remain sirup instead of turning into sugar. This variety has made a good record wherever it has been grown, and it is believed to be the best variety for all of the Northern States, where " a variety a little later than Amber " is desired.

The McLean variety has been grown at this station for three years. It is quite a large cane and grows very tall. In more humid climates this may be an objection. Although it has always had a very high percentage of sugar at this station it is not yet recommended for general distribution or extensive planting. It is not yet very uniform in type. When the seed was received from Australia, two varieties were mingled and many variations are found in the canes. There are very considerable differences in the height of the canes as well as in type, and it is believed that selections based on the physical characters of the canes will speedily modify its fault of too great height. In the selections already made from this variety several quite uniform subvarieties have been formed. This variety, although very rich in sugar, failed to give sirup of as good quality as some varieties which had much less sugar. Seed of this variety was sent to three sirup-makers in distant States and the variety was reported on unfavorably as a sirup-producer.

The Colman variety is confidently recommended. It originated in 1888 at this station from a cross of Amber and the Kansas Orange. At first very variable, it is now quite uniform. There are four subvarieties of the Colman, differing mainly in color of the seed. This variety has given very good results wherever it has been tried. Its canes are short and stocky when not too thickly planted. It ripens at the same time as the Orange. It gave fine sirup, all of which crystallized.

It is recommended that twelve other varieties, which have also given superior results at this station, be retained for future experimental culture and that all other varieties be discarded.

It is recommended that seed of the Folger, the Collier, and the Colman alone be given general distribution by the Department of Agriculture, and that seed of the McLean variety be distributed sparingly, for experimental purposes only, until it can be bred to a short and stocky habit of growth.

### EXPERIMENTS IN MANUFACTURE.

In addition to the culture work of this station, experimental work was begun in determining the qualities of different varieties in sirup manufacture. While many new varieties are being grown at this station for the purpose of selecting a few varieties which are best suited to sugar manufacture, it seems desirable that some attention be given to other qualities of the sorghum plant. In nearly all plants some varieties have special qualities which adapt them to certain special uses. It is certainly probable that some varieties of sorghum are specially adapted to sirup manufacture, as some varieties by abundant foliage and softness of fiber are specially adapted for forage. It is unlikely that one variety of sorghum will be found which will excel in the manufacture of sugar, in the production of sirup, in the production of seed for grain, and as a forage-producer.

The results of the comparative tests of several varieties are noted under each variety.

This work became greatly extended by experimenting with different processes for clarifying the juice. Many hundred clarifications were made in a small way, using many different methods. The most successful methods were again tested in a practical working way with apparatus suited to a two-horse mill, operating on 100 gallons of juice at a time, and were again tested in a larger way, operating by steam, with 500 gallons of juice at a time. The object of these duplicate tests was to fully work out all the details of size and arrangement of apparatus required by the new processes for the benefit of the sirup-makers who operate horse-power mills and who evaporate by fire pan, and also for those who operate on a larger scale, using steam power.

Four thousand gallons of sirup were made in those experiments. The quality was equal, if not superior, to the sirup from sugar cane. When the qualities of such sorghum sirup become known, it should rank with sugar-cane molasses and find as active demand and as ready sale as Louisiana sirup; all of the sirup grained, though graining was not desired. Sirup made from good cane by the process described can not be relied on to remain sirup. There are no reliable preventives of sirup turning to sugar known. There may be such means, and it is hoped to develop them another season, so that sirup or sugar may be made at will.

It was not intended in these experiments to exploit new and untried processes, but simply to select and to combine the processes which seemed to promise the best results.

The processes experimented with were as follows: The lime process, the lime and clay process, the lime and tannin process, the lime and acid process, and, finally, the cold defecation and acid process.

*The lime process.*—Where lime is used at all in sorghum-syrup manufacture, it is always used in insufficient quantity to effect a good defecation. The juice is intentionally left more or less acid on account of the injury caused by the lime remaining in the product. The result is an imperfect defecation, even when lime is used. In some cases an apparently good defecation may be had in acid juice, the liquid may be light colored and transparent, but in such cases the syrup and the sugar are often greenish in color, showing that defecation was imperfect. Lime always darkens the product, and for this reason it is never used in syrup manufacture in sufficient quantity, and in a great majority of cases there is no defecation except by heat. An extensive correspondence with sorghum-syrup-makers has brought the following sample replies: "I have used lime, sulphur, bisulphite, patent pans, and patent processes, and have quit them all." "With raw sorghum juice common sense is the surest way." "I allow the juice to subside a few minutes." "I rely on the energetic use of the skimmer." "If the juice is pure, I make good syrup; if it is impure nobody can."

But in sugar manfacture lime is added to the neutral point or to alkaline reaction. The greater part of the lime compounds are thrown off in the worthless molasses, but a lower grade of sugar is produced than would be the case if the lime had been entirely removed, after it had served its purpose in defecation. The process used at Calumet plantation in Louisiana may be taken as a sample of the lime-sugar process.

"The juice is sulphured cold, heated, and limed. It is allowed to settle from half an hour to one hour before decantation. About 2 inches of juice is removed from the surface of each defecation by the skimming and brushing; 35 inches of juice is decanted, leaving about 8 inches of settlings." (Bull. No. 23, p. 11.)

*The lime and clay process.*—In Dr. Shier's process, used in British Guiana, 1 per cent of bisulphite solution is added to the raw juice as it comes from the mill. A mixture of lime and clay batter is added to boiling juice. The result is stated: "The subsidence is not efficient without the addition of clay batter or some similar weighting matter. The syrup is fine and gives a superior sugar."

At the Khedive's famous sugar factory, Abael Wakf, Egypt, which is designed to work up 1,000 tons of cane per day, the juice is heated, sulphurous-acid gas is injected, milk of lime mixed with China clay is added, until the juice is neutral by litmus-paper test. The juice is run into subsider tanks, where it is allowed to settle. The perfectly clear liquid is decanted by sliding overflows. The subsidence and decantation occupy about forty minutes. The clarified juice takes about half an hour to subside. The whole operation of clarifying and subsiding requires one hour and a quarter. There are twelve settling tanks, each of 450 gallons' working capacity, and each one is fitted with a 5-inch Appold overflow for decanting the clear juice. (Lock & Newlands, p. 278.)

*The lime and tannin process.*—In the Sugar Planters' Manual, published in 1847 (page 101), is described a process for clarifying cane juice, which was used by Dr. W. J. Evans.

It consists in the use of tannic substances in the raw green juice, previous to any other defecation, with usual subsequent treatment.

A process was patented in Belgium by Leonard Wray, in 1854. "My process consists (1) in the cold defecation of raw juice by lime, immediately followed by filtration. (2) The treatment of the clear, bright liquor, resulting from this cold defecation with tannic substances, aided by heat, and subsequent filtration. By this process troublesome albuminous, glutinous, gummy, waxy, and mucilaginous matters, called feculencies, are entirely got rid of before they act injuriously, which they infallibly do the moment we apply heat to the undefecated juice."

In Mr. Wray's process, lime was added to the juice sufficient to neutralize the acids in the juice, and more lime to make the juice alkaline. After the lime had removed the impurities from the cold juice it was itself removed by the addition of tannin.

In 1887, Dr. Stubbs tested the tannic-process, first, by adding a solution of oak bark to the cold juice, with subsequent liming in hot juice; second, by adding the tannic solution to hot juice. With subsequent liming (Bulletin 10, Louisiana Sugar Experiment Station) "either of these methods gives excellent results, the latter perhaps the best, the former the most expeditious.

"These experiments indicate the success of oak bark in clarification. Tannin precipitates all, or nearly all, of the albuminoids of the juice, and juices thus treated were kept in a warm laboratory five or six days without a sign of alteration. Tannin precipitates starch, vegetable bases, and most of the coloring matters. Juices treated with tannin, then with lime, and with superphosphate of lime, were better defecated and gave larger returns than any other experiments made. The only objection found in many trials in the sugar house, followed by analyses in the laboratory, with close scrutiny of all working details, was the large quantity of settlings and the time required for their precipitation."

In this process, it appears that lime removes one class of impurities, the tannin removes another class, and finally the lime and the tannin neutralize each other.

*The lime and acid process.*—In 1882 Messrs. Belcher and Scharwz used phosphoric acid in cold sorghum juice before liming. They say, "With this reagent, we obtain a brighter colored and better flavored sirup."

In 1887, Dr. Stubbs experimented with phosphoric acid in sugar cane juice, after liming to neutrality. It is a valuable reagent, if used after liming to neutrality. A part of the phosphoric acid precipitates the lime and another part of the phosphoric acid unites with the potash and soda of the juice, forming almost harmless phosphates. No other acid will accomplish such good results."

[Bulletin No. 10 Louisiana Sugar Experiment Station.]

In 1883, Dr. H. W. Wiley experimented with sorghum juice, applying the methods which are successfully used in clarifying beet juice (Bulletin No. 3, p. 109). "The method consists in adding a large quantity of lime to cold juice, and then removing the excess of lime by a current of carbonic-acid gas, but leaving the liquid neutral or slightly alkaline. A large number of experiments indicate that 2 per cent of lime for diffusion liquor and 3 per cent of lime for mill juices are the best proportions."

"The results of these experiments were most flattering. In all cases the defecated juice was limpid and clear, but of a reddish yellow color; the taste resembled that of maple sap."

In 1886 Dr. Wiley again experimented with this process, using sugar-cane juice (Bulletin No. 14, p. 40): "To the cold juice 1 per cent of lime was added; the lime was removed by carbonic-acid gas until the juice was almost neutral. It was filtered and enough phosphoric acid was added to precipitate the remaining lime. The juice was again filtered.

"In every instance the sirup made in this way was very light in color, perfectly transparent, and of the finest flavor. So pure was it, indeed, that it was found unnecessary to use acetate of lead or any other defecating agent to prepare this sirup for polarization. I believe this process will make a noted improvement in the molasses over any other procedure now in use."

In reviewing the foregoing processes, there appears to be a gradual development of a superior process of clarification, from the experiment of Dr. Evans, in 1847, to the experiments of Dr. Wiley, in 1886.

The process is: (1) To use lime in sufficient quantity to produce a good clarification, even though this requires decided alkalinity and red color in the juice, and (2) the complete removal of the lime from the juice, after it has served its purpose.

It appears that lime is indispensable in clarifying cane juice, and also that lime in excess or to alkalinity gives superior clarification.

It appears that lime is in itself a damaging impurity when it is allowed to remain in the sirup.

It appears that the lime can be removed from the defecated juice by the use of tannic solutions, or by carbonic-acid gas, or by phosphoric acid. It is, perhaps, mainly a question of cost or convenience which of these reagents shall have preference; either will remove the lime.

It appears that cold defecation has decided advantages. On long standing, sorghum juice deposits slime, starch, seed grains, fragments of cane, and other impurities. The starch in sorghum juice is undoubtedly highly detrimental. Its removal seems possible only by cold defacation. There surely are advantages in removing impurities in the cold and again by heat.

It also appears that clay weights the flocculent impurities in limed juice and causes more rapid, more complete, and close settling. With sorghum juice this is more important, because its density is greater than that of beet juice or of sugar-cane juice. Twenty per cent or one-fifth of the weight of sorghum juice often consists of solid substances in solution or in suspension. The juice of dry canes is often so dense that settling can only be done by diluting the juice or by weighting the impurities. Settling is more rapid early in the season, when the juice is less dense. It is more difficult in times of drought. It is slow in juice from canes which have been cut for some days, and the settling of the limed impurities in cold juice is imperfect and slow. The fact that clay in cold, limed sorghum juice gives a better separation of the impurities, a brighter, clearer liquid, which is easily filtered, and which gives less scum in evaporation, may be easily verified by laboratory experiment and also by factory work.

The process which gave the best results at this station, all things considered, consisted in liming cold juice until a good defecation was had, adding lime, when necessary, until the juice was decidedly alkaline and the color red, the criterion being the clarification, not the color, the test being bright transparency in the liquid, even though alkaline.

Clay batter, like very thin mortar, was then added, sufficient to increase the density of the well-stirred liquid about 1° Baumé or 2° Brix. It was then allowed to settle, the time required being from one to two hours. Clear liquid was then drawn off from the surface by a swing pipe, care being taken to leave all the settlings in the settling tank.

The clear liquid was run into a clarifying tank. Phosphoric acid was added until blue litmus paper was slightly reddened, indicating faint acidity. It was then heated nearly to the boiling point, skimmed, and brushed. It was then allowed to settle from half an hour to one hour, and drawn off at the surface by a swing pipe, care being taken to leave the settlings in the clarifying tank. The light-colored and clear juice was then filtered. With such clear liquid filtering seemed unnecessary; yet it gives increased brightness. Pressure was not used in the filter press. The cloths were used one week without change, though that is not advisable on account of fermentation.

The clarified liquid was then ready for evaporation, in which there were no scums of account, for the impurities had been removed in the clarification.

Attempts to filter the settlings from the limed settling tank and the settlings from the acid clarifying tank were unsuccessful. Both settlings were run into a receiving tank, diluted with their volume of water, resettled, and the clear liquid was mixed with fresh juice. The final or washed settlings were sent into the sewer.*

## CLARIFICATION.

In liming the juice, cream of lime is added to the cold raw juice and well mixed with it. Blue litmus paper which has been reddened by dipping in unlimed juice, should be immersed in the limed juice. If the reddened litmus paper shows a slightly blue tinge of color it indicates that the juice is slightly alkaline. If not, more lime should be added until the juice becomes slightly alkaline. A test tube, or foot glass, should now be filled with the limed juice, placed in the light, and allowed to remain at rest for five minutes. The clear liquid, as seen between the flocks of precipitate in the test tube, should be bright, clear, and transparent. If it is not, more lime should be added to the juice and the test should be repeated. With some juices it is necessary to add lime until the juice becomes strongly alkaline and reddish in color. With other juices liming to the neutral point, or to slight alkalinity, gives clear juice, but in all cases lime must be added until the juice becomes clear and bright or a good defecation will not be had. Two points should always be borne in mind: if too little lime is used the juice will not be well clarified and if unnecessary excess of lime is used it will require excessive use of phosphoric acid to remove the lime in the subsequent treatment. As a rule it will be found that the juice should be made slightly alkaline. In 1857 Vilmorin said: "The best clarifications I have made were where I feared I had used too much lime," and this appears to be true.

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* 1 gallon clariphos to 400 to 500 gallons of juice; cost, 36 cents per gallon, by barrel, in St. Louis = one-third cent per gallon sirup.

Practice will soon determine, very nearly, the amount of lime required, but the exact proportion should always be finally determined by the appearance of the limed juice in a test tube, and this test should not be unduly hurried; the most careful person on the place should perform the clarification, for it determines the quality of the product.

The settling of the limed impurities is slower in cold juice than in hot juice; it is slower in dense or rich juice than in thin juice. It often happens that the impurities in cold sorghum juice have so nearly the same specific gravity or weight as the juice that they do not settle, unless weighted with some heavier substance which assists the settling. In experiments, sorghum juice of ordinary density and ordinary temperature, limed to an alkaline reaction and allowed to stand twelve hours, failed to give a good separation of the impurities. The juice could not be filtered, and in evaporation scums were thrown up, indicating imperfect clarification. It has been found that the addition of clay or of some similar weighting material is necessary to cold defecation of sorghum juice. Lime and clay assist each other in causing settling. If a hydrometer jar is filled with water made turbid with clay, the settling will be slow. If a little lime is added the particles of clay collect in flocks and quickly settle, but if a few drops of ammonia are added to the turbid water no flocks are formed and the settling is retarded, showing that lime hastens and ammonia hinders the settling of clay. A quicker settling is had with clay in limed juice than in unlimed juice.

All clays are not suitable for this purpose. With coarse-grained clays, the particles subside rapidly as sand would do, without carrying down the impurities. With very fine clays, the particles subside slowly giving bulky settlings which are easily disturbed in the decantation of the liquid and leaving the liquid turbid. It is found by experiment that some clays settle sooner, leave the juice clearer, and give more solid and compact settlings than other clays. In the experimental work at this station difficulty was at first experienced in finding clay suitable for settling cane juice. Many hundred pounds of clay was obtained at a distance of 60 miles. After making many tests, suitable clay was found in the immediate vicinity. Clay is a heterogeneous mixture which has been deposited from Nature's settling tanks. There are a vast number of varieties, having infinite differences. It is said by clay-workers that no two beds of clay are alike and that no two parts of the same bed are alike. It is often found that a difference of a few feet in the location or a difference of a few inches in depth gives clays having decided differences in qualities. In a small area nine distinct varieties of clay were found, and but one of them was well suited to settling juice. The qualities of clay depend upon the structure or arrangement of the particles, as well as upon the chemical composition. Clay often contains sand, dust sand, iron pyrites, potash and soda compounds, magnesia, sulphate and carbonate of lime. It should contain no substances soluble in juice. While it may be easy in some localities to obtain clay which is superior for the purpose of settling cane juice, it may be a difficult matter in other localities, and this subject requires study and experiment. To aid in this two hundred samples of clay were generously sent to this station, free of charge, from nearly every State and Territory, by makers of pottery, fire brick, building brick, vitrified brick, etc. These samples were carefully tested in settling cane juice. In general it may be said that fire clays are too coarse grained and do not carry down the impurities, that pure white clays are too fine grained and give bulky and indistinct settlings, that blue clays, gumbo, or waxy clays are not suitable, and that yellow or brown plastic clays are best. The presence of sand is a disadvantage only as it requires more of the clay to cause the settling. The presence of iron seems less objectionable from the fact that the acids in the juice are neutralized by lime before the clay is added to the juice. The exceptions to these general statements can only be found by experiments which may be easily made in a hydrometer jar, with small quantities of juice, and which also determine the percentage of the clay required to cause rapid and satisfactory settling in the juice.

It is advisable to soften all lumps in the clay by soaking in water for several days before using. The clay should be mixed to a cream or thin batter which will readily mix with the juice. Enough of the clay should be added to the limed juice to increase its density when well mixed, about 1° Beaumé or 2° Brix. The amount of clay which is essential to a good settling depends upon the quality of the clay and the density of the juice. In the experimental work at this station from 1 pound to 2 pounds of dry clay to 100 pounds of juice was sufficient.

As soon as the juice has been limed and clayed and well mixed it is advisable to fill a tall test tube, or foot glass, with the treated juice, and to allow it to settle. This shows at a glance the progress of the settling in the tank, and indicates the time the decantation of the clear juice may begin. A glass tube, longer than the depth of the juice, placed vertically in the juice, and having its upper end closed with the finger, when carefully withdrawn also gives a good section of the liquid.

A tank 36 inches deep, filled with cold, limed, and clayed sorghum juice should give 30 inches of clear juice and 6 inches of settlings in from one to two hours, sometimes longer, the time depending upon the temperature, the density of the juice, and the quality of the clay.

When the clear juice has been drawn from the settling tank, leaving the impurities with the clay in the settling tank, the lime having done its work should be entirely removed from the juice, for it forms bitter compounds in the juice and blackens the sirup. It is now an undesirable impurity in the juice.

In the experimental work at this station phosphoric acid was preferred, all things considered, as a means of removing the lime from the juice; 108 gallons of the acid phosphate of calcium, sometimes called superphosphate of lime, were used in the experiments. It was obtained from the Provident Chemical Company, St. Louis, Mo., the price being 36 cents per gallon by the barrel. Clariphos is a more concentrated and better solution. About 1 gallon of the acid to 400 or 500 gallons of juice was used. The amount of acid required depends upon the quantity of lime which was used in the defecation, and for this reason it is desrable to use no more lime than is necessary to secure a perfect clarification of the juice. The phosphoric acid combines with the lime, forming normal phosphate of lime, which settles out of the juice, so that both the lime and the acid are removed from the juice. It is advisable to heat the clear limed juice to nearly the boiling point, to add clariphos until the liquid faintly reddens blue litmus paper, which indicates that the juice is slightly acid. The object should be to remove all of the lime by combining it with the acid, leaving none of either in the neutral juice, and care should be taken to avoid having acid juice and acid sirup. As soon as sufficient acid has been added, it is advisable to fill a test tube or foot glass with the neutral juice, as was done before with the limed and clayed juice, and allow it to settle. This shows at a glance the effect of the treatment, the progress of the settling, and indicates when the decantation of the clarified juice may begin. From the fact that the addition of acid lightens the color even after all of the lime has been removed, there is a temptation to add too much acid, but only slight acidity, as shown by faint reddening of blue litmus paper, should be allowed, for in the subsequent evaporation the excess of acid becomes concentrated, making the sirup disagreeably acid.

The settling of the phosphate of lime in the hot, clarified juice is more rapid than was the settling of the limed impurities in the cold juice. A tank 36 inches deep gives about 34 inches of clear juice and 2 inches of settlings in about one hour. Attempts to filter the settlings or sediments were unsuccessful. The settlings from the lime and clay defecator and the settlings from the acid clarifier should be run into a receiving tank together, where they should be diluted with their own volume of water, and resettled, and the clear liquid should be mixed with fresh juice for reclarification, while the washed sediments should be run into the ditch.

In this process three decantations of the juice are made, drawing off the clear limed juice from the lime and clay defecator, drawing off the neutral juice from the acid clarifier, and drawing off the diluted juice from the washed sediments, care being taken in each case to reject the sediments. The liquid should always be drawn quietly from the surface. In the experimental work at this station swing pipes were used to decant the liquid. It seems that floating siphons may also be used. The Drummond Brothers, of Warrensburg, Mo., recommend a tin float attached to a loose-fitting swing pipe, as drawing from the surface of the liquid automatically.

The clarified liquid filters easily through cloth of any thickness, without pressure. A fine, granite sand, free from iron, is found at Holliston, Mass. It has been used fifty years in filtering cider, being shipped long distances for that purpose. With the assistance of Mr. William H. Holbrook, of that city, the sand was tested in filtering sorghum juice, clarified as described. It filtered readily through the almost impalpable sand.

Chemists and pharmacists have long used paper as a filter when fine filtering is desired. In recent years the use of paper as a filter has become common in filtering roily liquids. By using paper pulp the filtering sheet can be very large, and may be an inch or more in thickness. With the assistance of the Ripley Cider Purifier Company, of Sherman, N. Y., a thorough trial was made of paper pulp as a filter for clarified sorgum juice. As arranged, 150 gallons of juice was filtered per hour, producing bright and sparkling syrup.

A trial was made of Fleetwood's bag filters. They are cheap and convenient. A filter press was also used, many thousand gallons running through without pressure or change of cloths.

Though filtering is not as necessary with clear and bright juice as it is with cloudy juice, yet it gives greater brightness to the sirup by removing visible and also invisible particles from the juice. Filtering improves the appearance of even apparently pure well water, and when sorghum sirup-makers produce the best sirup they will use the best filters.

As the juice, when properly clarified, requires no removal of impurities during evaporation, it seems well adapted to the double or triple effect. For evaporation by steam, the Porter pan seems convenient and effective. For fire heat, a pan having three compartments, corresponding to the southern "train" seems to meet all requirements. When the juice is allowed sufficient time to settle very little scale is formed in the evaporation. The scale consists of phosphate of lime, which is very easily removed, being but slightly adherent.

It is certainly advisable for any one engaged in sorghum sirup manufacture to study and to practice defecation until able to perform it properly. A "book" of blue litmus paper, a saccharometer, a hydrometer jar, lime, clay, phosphoric acid, and a little sorghum juice or diluted sirup are the materials needed to become expert in clarifying juice.

In an experiment, a ton of unripe cane of the Folger variety was worked up immediately it was cut, without removing the green leaves. A ton of the same cane was carefully stripped of leaves and was at once worked. A ton of the same cane was also worked which had been cut and wilted for two days, the dry leaves not being removed before grinding. The three lots of juice were treated in the same way. The results appeared to indicate that the milling of the fresh-cut canes required less power, and gave better extraction of juice than the milling of the wilted canes. The juice of the unstripped canes gave more bulky sediments than the juice of the canes whose leaves had been removed, while the sirup was as good in quality from unstripped as from stripped canes, and as good from fresh cut, as from wilted canes.

In an experiment, bone dust, that is, the fine siftings from animal charcoal, rejected by sugar refiners, was added with phosphoric acid to the hot juice. After standing twelve hours, the juice was still inky from suspended particles of bone black dust. The experiment was repeated, the phosphoric acid, bone dust, and clay being added at the same time to the hot juice. In an hour, the subsidence was complete, the liquid being clear; 300 pounds of bone dust were used in these experiments, at the rate of 1 pound to 10 gallons of juice, the bone dust costing 1¼ cents per pound. It appeared to improve the sirup. It seems it should improve the flavor and color for there is no better decolorizer and purifier than bone coal, and it appears that the use of the cheap siftings or dust from refiners' char may become practicable by using clay to clear the bone dust from the liquid.

Extra pressure and double milling extract more juice from sorghum cane, and also more impurities from the cane; where repeated pressing has been used the quantity of sirup has been increased at the expense of the quality. Light pressure of canes whose rinds are hardened by wilting or drying often gives better sirup because less impurity is extracted from the shell of the canes. In experiments it was found that juice from double milling, with and without moistening the baggasse, and also juice from single milling, under excessive pressure, gave more bulky settlings and gave as clear juice as ordinary pressure, with larger yield.

In the experimental work, the proportions of lime, clay, and acid, time of settling, etc., were varied, so that each lot of juice treated was in the nature of a distinct experiment. A record was kept of each lot, and the following is a sample of the record:

*September 29.*—Tank No. 1 contained 480 gallons of juice; the density by the Brix saccharometer was 21. Limed past the neutral point, added clay until the density of the juice was 22.5, allowed to settle one hour and ten minutes, drew off 440 gallons of clear juice into tank No. 2, added 1 gallon of clariphos, heated and skimmed, allowed the juice to settle forty minutes, drew off the clarified juice and filtered. The resettling of the sediment took one hour; the density of the clear juice from the diluted resettling was 9 Brix. The result was a light-colored, fine-flavored sirup.

An effort has been made to describe the above process fully, because sorghum sirup manufacture appears to need a better process of clarifying the juice. The production of sorghum sirup in the past twenty-five years has probably averaged 25,000,000 gallons annually. In the West the sirup mill should lead to the sugar factory, as it does in the South. But sorghum sirup manufacture is not prosperous or progressive. It has impure juice to deal with and practically no means of defecation except heat. The product has no standard color, flavor, or price. It is not quoted in any market. It is not called for in any wholesale way. It has not variety of prices, for the quantity of inferior rules the price of all. It is doubtful whether the iron mills now in use give as good sirup as the weak wooden mills used thirty years ago, for increased extraction give more need of superior defecation. The experience of thirty years shows that sorghum sirup manufacture can not be generally successful with any method of clarification now in use.

The experiments made at this station appear clearly to show that sorghum juice can be well clarified, and that a superior quality of sirup and of sugar can be made by using sufficient lime to effect a good clarification, separating the impurities from the juice, and then completely removing the lime from the clarified juice, with final evaporation in any approved way.

The experiments indicate that this process is sufficiently simple to be used by horse-power mills, by steam-power mills, and, possibly, by diffusion sugar factories.

The experiments which have been made at this station seem plainly to show that the method which has long been used in clarifying beet juice for sugar manufacture is also applicable to clarifying sorghum juice for sirup and for sugar manufacture.

It consists in using sufficient lime to secure good defecation and then removing the lime.

The method used in sugar-cane manufacture consists in adding lime and in allowing the lime to remain in the juice, to the injury of the product. And this is the method now used in sorghum manufacture when any defecation other than by heat is attempted.

## COLD CLARIFICATION.

By Mr. GLENN O'BRIEN.

There has for several years been an opinion among a considerable number of those connected with the sorghum industry, that some plan for thoroughly removing suspended matter contained in juice, before boiling took place, would be of great value. With a view to devise some system of cold clarification, very many efforts have been made during the past thirty years, meeting with little or no success. Various substances have been used to remove suspended matter continued in juice, among which may be mentioned marble dust, sand, gravel, powdered rock, gypsum, clay, etc. All of the work so done was of a desultory character, and, with the exception of work done by the U. S. Department of Agriculture, during the past season, there is not at this time any record of systematic work in this direction.

During the winter of 1891-'92 the writer conducted many experiments in cold clarification, with clay and lime used in different proportions. At first clay alone was used, but, the results not being satisfactory, lime was used in connection with it.

At that time juice could not be obtained, and sirup containing a large amount of impurities was diluted to 18° Brix, and lime and clay added. It was found that the lime coagulated much of the suspended matter, and clay added to increase the Brix reading from 1½° to 2°, would carry down all the particles in suspension, giving a clear limpid juice, which produced little or no scum on being boiled. It was also ascertained that the dilute sirup thus treated would pass readily through very fine cloth, while without such treatment it would soon gum up cloth of a very loose texture.

Such results led to the conclusion that, in addition to the suspended matter contained in the solution, much or all of the gum was removed; on testing with a strong solution of alcohol only a very small amount of gum could be collected.

While experiments up to this time were very satisfactory, still it was a matter of doubt whether like results could be obtained with cane juice as it came from the mill. During a series of experiments it was found that the treatment which gave such good results on dilute sirup was equally satisfactory in working cane juices.

More lime was used and the juice made neutral, or slightly alkaline, after which the excess of lime was corrected by the use of phosphoric acid. The acid also made a much more transparent juice.

It may be said in this connection that although the acid made the juice very bright and transparent, there is at this time some doubt whether its use as a clarifying agent is to be encouraged. After a season's work experimenting on the line above indicated there is reason to believe that the sirup is in no way superior to that made by lime and clay alone.

It has been demonstrated by a long series of experiments that lime and clay together, with or without phosphoric acid, effectually clear all kinds of sorghum juice from suspended matter, so that juice thus treated will pass readily through fine paper pulp, filter press cloth, or any other fine filtering substance used for filtering sugar liquids, and that, too, without pressure.

The readiness with which juice thus treated has been filtered during the past season has been a matter of comment among those who have heretofore attempted to filter sorghum juices.

### DETAILS OF THE PROCESS.

The juice after being pressed from the cane is allowed to flow to settling tanks, of which there are sufficient to hold the juice while the press is running for six or seven hours, allowing one hour to fill each tank. As soon as the tank is full, milk of lime is added to make the juice neutral, also finely-mixed clay to make Brix reading 1½° more than the juice itself tested. After being well stirred the whole volume is allowed to settle for a period of from two and a half to four hours, the time to be determined by settling of sample in glass, containing a portion of the liquid after clay and lime have been added. If the work has been properly done the juice will be freed from most of the suspended matter, and no green color will be noticeable. The amount of clear juice obtained will depend somewhat on its density; suspended matters in light juices settling much better than those in heavy ones.

After the mixture has stood from two and a half to four hours, from 70 to 80 per cent of the volume can be drawn off as clear juice. The sediment will of course contain juice, lime, clay, and impurities mixed together, and by adding water in equal volume to the sediment, and allowing same to settle from one and a half to two hours, about 60 to 65 per cent of saccharine matter contained in sediment can be saved.

### AFTER-TREATMENT.

The clear juice is drawn off by means of swing-pipe valves, great care being exercised so that none of the sediment is taken. The pipes for this purpose should be of sufficient size to do this work quickly, so that no time is needlessly consumed in attending to it. The juice so drawn off is pumped to its clarifier for hot clarification. When the clarifier is full, phospheric acid is added in the proportion of one part of acid to about 400 parts of juice, the amount varying somewhat on account of variation in the strength of the acid. Steam is then turned on and the juice brought to boil, the scum being removed in the ordinary way. If the work has been properly done, there will be only a very small amount of light frothy scum. Phosphates formed by the action of lime and acid will rapidly subside, leaving a very transparent juice which may be easily run through any of the filters ordinarily used in sugar-house work.

It may be here remarked that for reasons above given the acid may be dispensed with. In this case, instead of liming to neutrality, lime should be used in the same quantity as for sirup making, *i. e.*, the juice remaining slightly acid. Clay is added in the proportions given, and the juice drawn off, pumped to clarifier, brought to a boil, and skimmed in the ordinary manner.

There seems to be very little difference in the quality of the sirup resulting from either of these methods of clarification. When the work has been properly done, in either case, little or no skimming will be required while evaporation is taking place.

### SETTLING TANKS.

Settling tanks may be made of iron or wood. As a result of the work so far done it may be said that tanks for settling purposes do the best work when they contain a depth of juice of from 18 to 24 inches. The washout holes should be large—2 inches or more in diameter—so that sediment can be readily removed. The construction of the tanks should be such that the washout holes will drain every portion of them. The bottoms, except small slope for drainage, should be level. Sides should be perpendicular or nearly so, that no sediment may lodge on them. Swing-pipe valves may be made similar to any of those now in use. Iron tanks are easier kept clean than wooden ones, and for that reason they are preferred.

### COST OF THE PROCESS.

From what has already been said, it will be understood that when clay suitable for clarifying is found in the locality where it is to be used, its cost will be a mere trifle. Where clay has to be shipped for the purpose, the cost will of course be considerable, varying according to distance shipped. One ton of dry clay used without wasting will clarify the juice from about 100 tons of topped cane.

A small grinder or mixer is absolutely necessary, and a quantity of mixed clay should be constantly on hand so that no time is lost.

The best clays for the purpose have been found quite difficult to mix by hand, and during this season's work much time has been lost by reason of poor arrangements for handling clay.

With proper facilities one person will be able to attend to all the work of cold settling and pumping juice to clarifier. Where phosphoric acid is used the cost at present price of acid will be about 40 cents for each 400 gallons of juice clarified.

### NECESSITY FOR CLEANLINESS.

It is absolutely necessary that all pipes and tanks should be kept scrupulously clean, as, if they are allowed to become sour, juice will ferment in a very short time. When tanks were well cleaned, and juice allowed to flow to them without pumping, it has frequently been kept from twelve to twenty-four hours without any visible sign of fermentation.

A period of five or six hours for settling and resettling has been found amply sufficient for the purpose. Juice well handled suffers little or no deterioration in that time, this having been determined by numerous polariscopic tests during the present season.

### LOSSES.

Very many experiments have been conducted to determine the loss occasioned by this process. The record given in another place is a fair representation of average working results obtained in this season's work.

It is to be regretted that the exact weight of juice, lime, and clay could not be determined. All the data now at hand have reference simply to volumes, the same being determined by careful measurements of tanks. In clarifying juice of ordinary densities it has been found that the first settling gives from 70 to 80 per cent of clear juice, *i. e.*, a volume equal to percentage named of whole amount of juice after lime and clay have been added. In the second settling, where water has been added in equal volume to the settlings, it was found that about 60 per cent could be drawn off and saved. Taking the volume of juice first drawn off at 75 per cent, and 60 per cent of remainder at second settling, there would be secured 90 per cent of the saccharine matter contained in the juice. This is reckoning simply by volumes, and in reality there is considerably more saved, as the lime, clay, and suspended matter in the juice amount to from 3 to 5 per cent of the whole volume.

Good authorities give the loss from scums and settlings in making sorghum sirup as 20 per cent. As there is very little scum in clarifying or evaporating juice that has been previously treated with lime and clay, it will be readily seen that the loss by this process is not so great as by the old methods.

It has been the experience of sorghum manufacturers generally that good sirup can not be made from cane freshly cut. Cane has been cut and allowed to remain several days, and sometimes weeks, before being worked, the result being that a much better article of sirup was obtained, but the quantity was much less than could be secured in working freshly cut canes. By using the process herein outlined, good sirup, entirely free from green vegetable matter, can be obtained from unstripped cane, worked as soon as it is cut. It will be readily understood that this will result in a greatly increased yield of sirup.

### KIND OF CLAY TO BE USED.

Experiments have been tried with many varieties of clay with different degrees of success. Many of the clays tried were wholly unfit for this purpose. Clay to be used for clarifying should be very heavy, capable of fine subdivision, and free from soluble matters. Clay of this character will settle readily and give a clear juice.

A large number of samples of clay, from nearly every State in the Union, is now being tested, the object being to ascertain those clays best adapted for the purpose of clarification.

### EXPERIMENTS WITH MILL JUICE ONLY.

It has been supposed that the boiling of sorghum juice renders soluble some of the objectionable solids which it contains, and that they can not afterwards be removed. For this reason it is thought best to remove all suspended matter before boiling takes place. It is a matter of doubt whether diffusion juices would be benefited by this process, as boiling heat is necessarily used before clarification, thus rendering soluble some of the impurities.

### AMOUNT OF CLAY AND LIME USED.

Very many experiments were tried before determining the exact quantity of clay necessary to do good work. It was found that too much clay would not settle close enough, while too little would leave very little sediment and do no good. It was finally determined that sufficient clay well mixed with water should be added to the juice to increase its normal Brix reading from 1½° to 2°, 1½° being the amount which is most often needed.

Lime was first used to simply correct the acidity of juice, but it was found on examining closely that milk of lime, used to make juice neutral, or nearly so, would, even without heating, collect most of the suspended matter in the juice. These particles were not heavy enough of themselves to subside readily, and it was found that clay, used in the right quantity, would attach itself to them with sufficient tenacity to carry all down together.

### CRYSTALLIZATION.

It has long been known that sorghum juices contained a high percentage of sugar, most of which, for some cause or other, refused to crystallize. The researches of the chemists of the Department of Agriculture showed that the failure of sorghum masse cuite to crystallize was owing chiefly to the presence of certain vegetable matters, gums, etc., contained in the juice. The statement was also made that alcohol would remove such impurities, which statement was verified by experimental work done the ensuing year by the Department of Agriculture at Medicine Lodge.

After having ascertained that it was the presence of objectionable matters named that made crystallization to a great extent impossible, it was thought that some other inexpensive process that would remove starch, gums, and vegetable matters from the juice would give results approximating those obtained by the use of alcohol. As a result of numerous experiments conducted on a working scale during the past season, it can be truthfully said that the crystallization of sirup from well clarified sorghum mill juices is an assured fact. Juice from freshly cut cane, clarified by this process, and boiled to 75° Brix and upwards has never failed to crystalize freely.

### SATURATION AND REPRESSURE.

There were two experiments tried by me on cane raised in Kingman County to ascertain the amount of juice which could be saved by saturating and repressing the bagasse. The experiments were carefully conducted, the cane weighed, and the juice measured and tested. The calculation was made from tables given in Tucker's Sugar Analysis. After the cane had been passed through the rolls in the usual way the bagasse was thrown into water, and afterwards repressed. In each case the yield of sirup from topped cane, after allowing for waste, was a trifle over 20 gallons to the ton of 75° Brix sirup. Clarification with this juice was much easier, as there was considerable dilution. The sirup was of about the same quality as that made without saturation from the same variety of cane.

### WILL IT PAY?

In answer to this question—which must be considered the most important that can be asked—it can only be said, that the indications are that factories can be made to pay where good cane can be raised in close proximity to the factory or purchased at a moderate price. All of the attempts to make sorghum sugar since the year 1884 have been with the diffusion process. And it can be truthfully said that there is not now a really good mill used for milling sorghum canes. It will be necessary to adopt Southern methods of presswork, at least so far as pertains to saturation and repressure.

Assuming that sorghum is rich in sugar, it can be made to pay with a sugar output much less than that obtained in the South, for the reason that sorghum can be bought or raised for about one-half the price paid for cane in Louisiana.

### PAPER-PULP FILTERS.

Paper-pulp filters, made from fine filter paper, and spread over a cloth with proper protection, were used to filter juice after it had been clarified.

These filters worked well, and left the juice perfectly transparent, the only objection being that the pulp needs frequent cleaning to prevent souring.

### FILTER-PRESS CLOTH.

Several times clarifications were made with lime and clay, the juice being afterwards passed through filter-press cloth. For this purpose a frame was used 8 feet long and 28 inches wide, to which the cloth was tacked. It was found that a piece of cloth of this size would let juice pass through it as fast as it came through an inch pipe.

### BONEBLACK.

An experiment was tried with bone black used in the proportion of 100 parts of juice to one of the bone black, the object being to decolorize the juice. The boneblack was mixed with the juice and enough clay added to carry it down. The result was a partial decolorizing of the juice, but the waste and trouble attending the process would not admit of its being adopted.

### NEW VARIETIES OF CANE GROWN IN KINGMAN COUNTY, KANS.

Early last spring I received from the U. S. Department of Agriculture seeds of six varieties of cane, namely, Folger, Coleman, Link, McLean, Collier, and African. All seeds received were planted, also Amber and Orange from seed raised in this locality. The seeds from the new varieties were planted on May 27 and 28, and all the conditions as to soil, cultivating, and thinning were the same, as nearly as possible. The seeds were thoroughly cleaned and planted with a planter, with rows 3½ feet apart, and hills in rows every 30 inches. All varieties planted made a good stand. The cultivation was good, the cane being well hoed twice, and thinned. Weeds did not in any way interfere with the growth of the cane.

All varieties grew well until July, when a drought began, which for severity has never been equaled in this country since its settlement.

The drought and cinch bugs so damaged the crop that much of it was worthless for sirup-making, though there was a fair crop of seed grown.

### *Link.*

This variety was a little too thick on the ground, but stood the drought well, and yielded a good crop of seed, which ripened evenly. The cane was over ripe when worked, but yielded a fair amount of good sirup.

### *Collier.*

This cane grew very spindling with very profuse foliage, much of which was badly fired. A portion of the seed ripened while rest was still very green. The result was that when rain came a second growth took place which made the field worthless for sirup-making. There were 1½ acres of this variety planted.

### *Folger.*

There were 2 acres planted to this variety, and it was the most satisfactory of any cane grown. The drought seemed to have little effect upon it, and the stalks made an even growth, averaging 8 feet in height. The crop was a really good one, and had it been seasonably worked would have yielded an excellent crop of sirup. The sirup made from this cane was much better than that from any other variety raised.

When cane was worked, juice tested from 23° to 25° Brix.

Folger is undoubtedly the best cane ever grown in this locality.

### *African.*

This sort seems to have little to recommend it, as it was a complete failure with me this year; seed poor, fired badly, and ripened unevenly.

### *Colman.*

A portion of this cane grew on low ground, and the stalks were large and yielded a good crop of seed. Stalks resembled those of the best strains of orange, with perhaps some more foliage. About one-half of that planted was a good crop; rest very poor.

In ordinary seasons this will be a good variety to grow, as it will not be likely to break down.

Juice at time cane was worked tested from 22° to 24° Brix.

### *McLean.*

This variety was planted on ground adjoining that where Colman was planted, and in the low ground the stalks grew very tall and lodged badly. It is to be feared that a crop of this variety will always lodge in good seasons, and for that reason it will not be extensively cultivated.

### *Amber.*

Seed of this variety planted April 15 produced an excellent stand. The crop suffered severely by drought, and only little of it was cut.

Amber will not be grown after people learn of the superior qualities of Folger.

### *Orange.*

Seed of this variety was obtained from Medicine Lodge last season and did well here. Of this sort little needs to be said, only as comparing it with the newer varieties.

The cane this year grown was far inferior to the Folger in every respect, and especially in that important particular of withstanding drought. It ripened very unevenly and made only a small amount of sirup.

It now seems likely that one of the new stocky varieties, perhaps the Colman, will take the place of the Orange cane.

*Record of two experiments in cold settling under ordinary conditions.*

*October 3.*—Tank filled to a depth of 17½ inches, and milk of lime added, leaving juice slightly acid; clay well mixed added to increase brix of juice 1½°. After settling three hours 13½ inches of juice were drawn off, leaving 4 inches of sediment, to which an equal volume of water was added. After settling two hours 5½ inches of dilute juice were drawn off, leaving 3½ inches of sediment. Dilute juice was one-half the density of juice first drawn off. Seventy-seven and one-tenth per cent was drawn off after first settling, and 63.6 per cent of the remainder at second settling, making 91.66 per cent of whole volume.

*October 28.*—Tank filled to a depth of 18½ inches. Brix of juice 23.3. Lime and clay added, making density of mixture 24.8° Brix. Began settling at 1.30 p. m. Drew off 14 inches at 4 p. m., leaving 4½ inches of sediment. Added 4 inches of water, and drew off 4⅝ inches of dilute juice at 7 p. m., testing 11.9° Brix., and left in tank 3⅞ inches of sediment. First settling gave of clear juice 75.67 per cent of whole volume. Fifty-four per cent of the remainder was obtained at second settling, making 88.8 per cent of whole volume.

These tests are average ones, taken from a large number, under ordinary working conditions. The percentages are calculated on volumes, no allowance being made for clay, lime, and vegetable matters in the juice. These being taken out, it would make total percentages saved from 2 to 4 per cent greater.

Tanks were slightly sloping on the bottom, with perpendicular sides. Measurements were taken in the center of the tanks.

## METHOD OF SIRUP MANUFACTURE EMPLOYED BY J. P. WHERRY.

I lay in a supply of clay before I commence grinding; have about forty 50-gallon barrels arranged in rows; each barrel has two wooden faucets, one about 7 inches from the bottom, the other about 7 inches higher. I put in one-half bushel clay and one-half pint milk of lime to each barrel that I expect to use before I add any juice. Then as soon as there is enough juice ground I draw it off through an inch hose, running enough in each barrel to cover the clay (about six or eight barrels to commence with, preparing the other barrels later as I need them). Now, by the time the tank at the mill is full (it holds 100 gallons) the clay in the first barrel will be soaked enough to easily disintegrate. I now stir it thoroughly before filling the barrel with juice so as to have every particle of the clay separated. I then fill up the barrel and keep stirring while the juice is running in, using a good stout dash similar to that used in the old dash churn. Now, if the work is well done the foam on top will be free from the green color of the juice. Right here let me say you must give it a good stirring, and some juice requires more stirring to make the green go down.

In warm weather when the temperature is above 60° I grind in the forenoon and boil in the afternoon, allowing the juice to stand about six or eight hours; when the weather is cool enough so that there is no danger of souring I let it stand about twelve hours. We use a Cook evaporator, size 5 by 30 feet; only a few channels in the receiving end have any green scum. Remove the scums about every fifteen minutes with a skimmer. Although there is much work in preparing the juice, I consider it is saved twice over in running the pan, and then when you come to compare the sirup with that made from the raw unprepared juice the difference is greater. We have here a kind of faint yellow clay with grayish streaks free from gravel or sand. It is about 2½ or 3 feet below the surface. The sand in clay is of no use, as it settles too soon to carry the impurities down with it.

When I commence I get about one bushel of lime and slack in a barrel and put water enough in to make about 40 gallons. I use this to cleanse my barrels and to put in the juice, taking care not to put enough in to color the juice dark. If you get a little too much lime in one barrel put less in the next, and in running it together in the pan no harm will be done. After drawing the juice all off from the first barrel filled, I empty out the clay and thoroughly wash out the barrel. Usually in the morning I dip out a bucket full of clear lime water (before stirring it to put in the juice); this I use to rinse out the barrels to keep them from getting sour.

We make a very fine sirup; about the only trouble is it goes to sugar too much. We use the Amber. I think it is the best for our latitude. The crop of 1892 here was light; we made 1,300 gallons; last year, 1891, we made 5,000 gallons. In reference to the business, I think as soon as manufacturers of sorghum get to understand as well how to work up the cane as other factories that are perfected through long experience, the sorghum plant will be as much of a necessity as corn or potatoes or any other of the staple crops. The testimony of my patrons is that they will not use any other sirup as long as they can get good sorghum.

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